

Compressed Air

NOVEMBER 1955

Magazine



GRIST MILL IN
NEW ENGLAND
Meal is still ground here
to make bread served
at a nearby inn

PHOTO BY J. D. BROWN, INC.

VOLUME 60 • NUMBER 11

NEW YORK • LONDON

Cuts 60 Second Metal Drilling Job to 15 Seconds... with Air Punching Tool

A sub-contractor for a large auto manufacturer formerly used two men, an electric drill and a drilling jig to drill two $\frac{1}{4}$ " holes in rear auto fenders.

This method required a whole minute and failed to provide uniform results. In addition, paint damage and broken drills caused excess time loss.

AIReengineering by Ingersoll-Rand solved the problem fast. A size AR130 Air Buck Riveter was equipped with special yoke, punches and stripping mechanisms. The holes are now punched four times faster, with closer tolerances and only *one* man is required instead of two.

If you are in a position to encourage cost-savings in your plant, you should see I-R's confidential manual reports on "AIReengineering at Work". Write on your company letter-head and we'll arrange for you to see it soon.



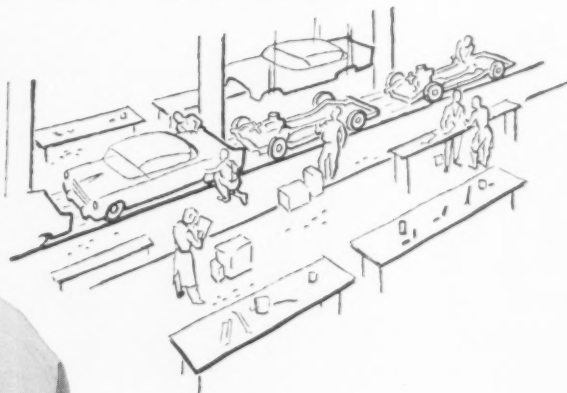
AIReengineering Manual

Over 100 interesting and helpful case history applications of AIReengineering at work.

Ingersoll-Rand

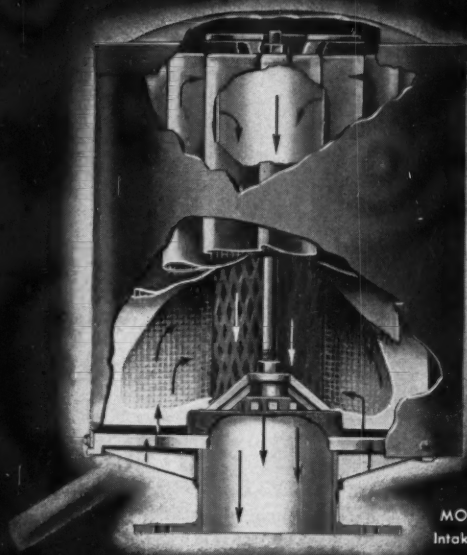
11 Broadway, New York 4, N.Y.

Air Buck Riveter
Punching two $\frac{1}{4}$ " holes
in rear auto fender.



8-257

YOUR EQUIPMENT
WILL LAST LONGER
with **STAYNEW**
INTAKE FILTERS!



MODEL D
Intake Filter

AND HERE'S WHY! Your equipment needs the protection Staynew Intake Filters are designed to give. Staynew Intake Filters stop the dust and dirt from entering through air intakes. Staynew's *Positive Protection* keeps shutdowns and repairs at an absolute minimum, actually lengthening equipment life. And Staynew itself requires less attention than ordinary intake filters, frequently operating two or more years *without maintenance*.

Write today for catalog S. I. F.



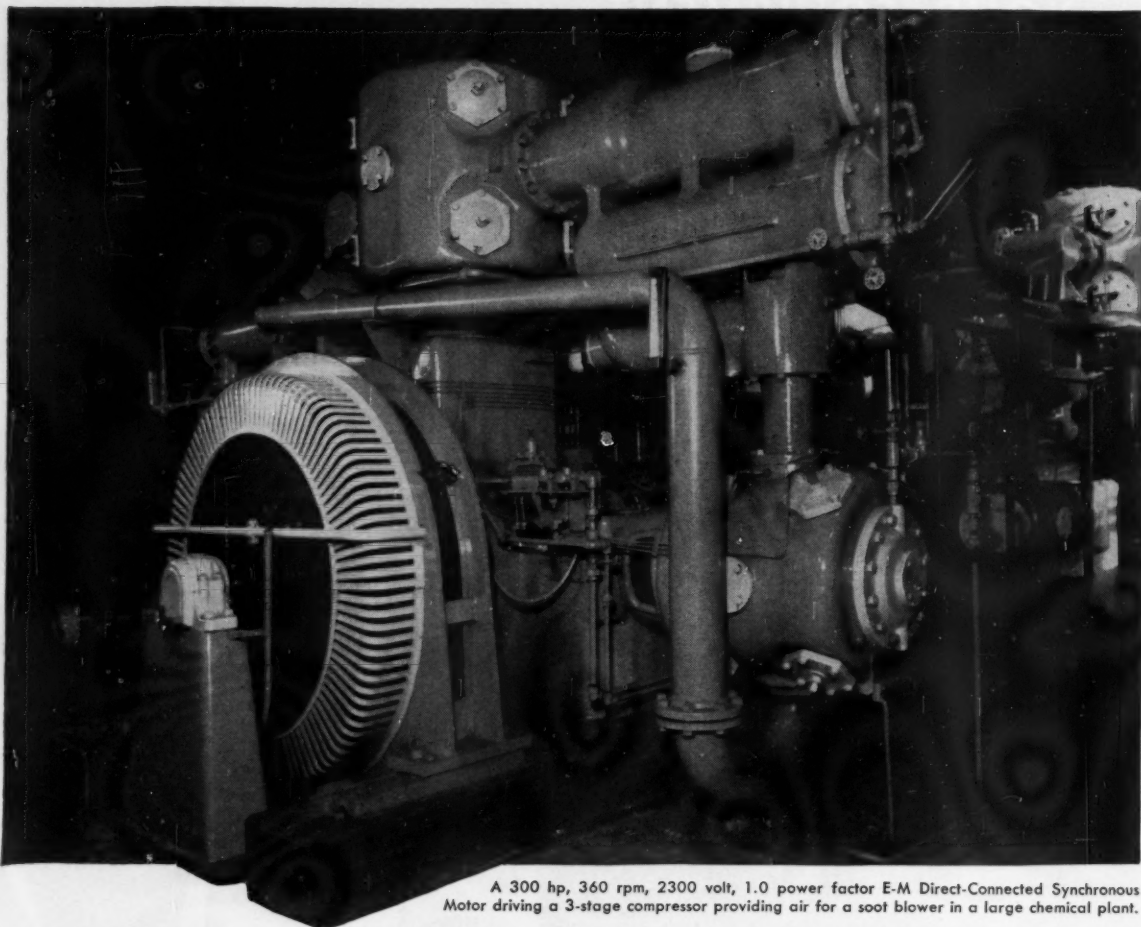
Representatives in Principal Cities

DOLLINGER
CORPORATION

7 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED





A 300 hp, 360 rpm, 2300 volt, 1.0 power factor E-M Direct-Connected Synchronous Motor driving a 3-stage compressor providing air for a soot blower in a large chemical plant.

What every new compressor should have

● Nicest thing you can do for a new large compressor is to couple an engine-type synchronous motor to it. There's no better way to assure a most economical, reliable and trouble-free drive. Look at the advantages:

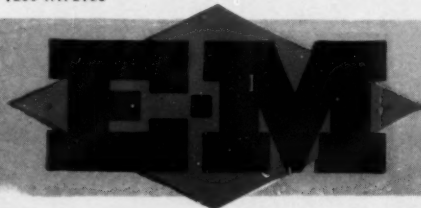
1. **HIGH EFFICIENCY** conversion of electric power to mechanical power by synchronous motors . . . resulting in minimum electric power cost operation of the compressor.
2. **POWER FACTOR CORRECTION** by unity or 0.8 leading power factor synchronous motors . . . supplying leading reactive kva to improve plant power factor and further reduce power costs, save money on your power bills.
3. **DIRECT-CONNECTED** synchronous motors save valuable floor space and require minimum maintenance.
4. **SIMPLE STARTING** at full voltage is suitable for most direct-connected synchronous motor compressor applications. Or you can use E-M-invented part-winding starting where starting limitations are severe. E-M starting arrangements are low in first cost and maintenance cost.

And there's nothing nicer for your compressor than an E-M Direct-Connected Synchronous Motor. E-M, pioneers in the development of synchronous motors and control, have over 40 years' experience in the design of synchronous motors incorporating desirable characteristics and features such as those above.

Let the E-M specialist engineer team design a smooth-running, modern drive unit to meet the requirements of your new compressor application. For complete information on E-M Synchronous Motors and their application in your plant, consult your nearest E-M sales engineer. And write for the issue of the E-M Synchronizer titled "The ABC of Synchronous Motors".

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

1200-TPA-2136



**SPECIALISTS IN
BIG MOTOR ENGINEERING**



Bethlehem Hollow is used in construction at Erie Mining Company taconite project, north of Aurora, Minn., and at Taconite Harbor on Lake Superior (above). Plant Contractor: Foley Constructors of Minnesota (Foley Bros. Inc., St. Paul Minn., and Pleasantville, N.Y.); Harbor Contractor: Dravo Corporation, Pittsburgh. Drill steel reconditioned by Barrett Drill Service, Eveleth, Minn.

Moving 4 Million cu yd of Hard Rock for Taconite Development Program

To help conserve the nation's supply of vital iron ore, the Erie Mining Company is playing a leading role in the development of a new industry, taconite mining, near Aurora, in northern Minnesota. The project is a huge one. The rock must be blasted, and crushed to fine powder. The ore, recovered magnetically, is then rolled into small balls, which are specially treated to develop hardness for easy handling. The end product, taconite pellets, has an iron content of more than 60 pct.

Site of the development, not long ago a wilderness, is now bustling with activity. An entire new community has been built. Mill buildings and dock facilities are well advanced, and a railway is under construction.

The operation involves the excavation of approximately 4 million cu yd of hard rock. Bethlehem Hollow Drill Steel, in 1-in. hexagons and 1¼-in. rounds, and fitted with carbide-

insert bits, is used exclusively in this task. About 85 pct of the drilling is being done by wagon drill, the rest by jack-hammer. Normal blast-hole depth is 17 ft.

Bethlehem Hollow Drill Steel is ideal for all kinds of rock-removal jobs because it is rolled from a tough, fatigue-resisting steel. It has a wide quenching-range, making it easy to heat-treat for the ideal balance of hardness and wear-resistance. Bethlehem Hollow also makes long-wearing threads and tough shanks. It comes in rounds, hexagons and quarter-octagons, generally in lengths of 18 to 25 ft. It's good steel to keep in mind for your next drilling job.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation



BETHLEHEM HOLLOW DRILL STEEL
TWO GRADES: CARBON • ULTRA-ALLOY (chrome moly)

SPECIFICALLY ENGINEERED...
NEVER MERELY ADAPTED...
FOR EACH PARTICULAR
TYPE OF APPLICATION

HANSEN

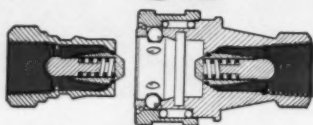
QUICK-CONNECTIVE COUPLINGS



ONE-WAY SHUT-OFF

Shuts off one side of line

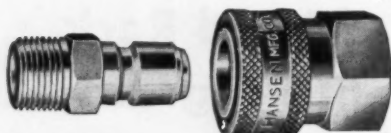
Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect Coupling and open line to flow of fluid, merely push Plug into Socket. To disconnect, a slight pull on sleeve releases Plug and shuts off supply end of line.



TWO-WAY SHUT-OFF

Shuts off both sides of line

To connect, pull back sleeve and push Plug into Socket. Identical torpedo type valves permit free flow of gas or liquid through Coupling. To disconnect, pull back sleeve . . . Coupling immediately disconnects, valves automatically seal both ends of line. Female pipe thread connections from $\frac{1}{8}$ " to 1". Available in brass or steel.



STRAIGHT-THROUGH COUPLING

Provides quick connection and disconnection, but does not have shut-off feature. Sizes, ranging from $\frac{1}{4}$ " to $2\frac{1}{2}$ ", carried in stock. Two special types of straight-through steam Couplings also available—one for low pressures, and one for high pressures.

Quick-Connective Fluid Line Couplings for
AIR • OIL • GREASE • HYDRAULIC FLUIDS
REFRIGERANTS • VACUUM • STEAM • OXYGEN
ACETYLENE • GASOLINE • COOLANTS • WATER

Write for Catalog

HOSE CLAMPS • HOSE CLAMP PLUGS
HOSE CLAMP SOCKETS • HOSE CLAMP COUPLINGS
AIR LIQUID SPRAY GUNS • AIR BLOW GUNS
SAND BLAST CLEANERS • ENGINE CLEANERS

SINCE 1915



THE HANSEN

MANUFACTURING COMPANY

4031 WEST 150th STREET

CLEVELAND 11, OHIO

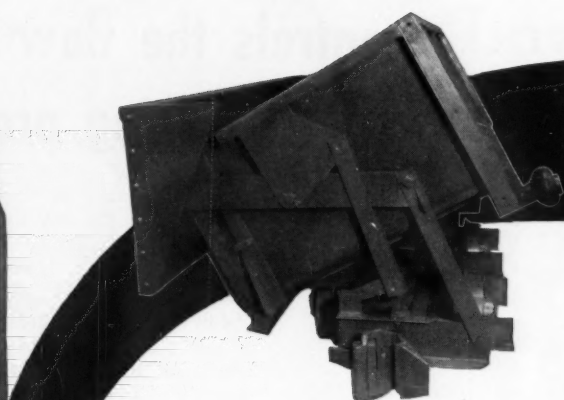
Representatives in Principal Cities

QUICK-CONNECTIVE FLUID LINE COUPLINGS



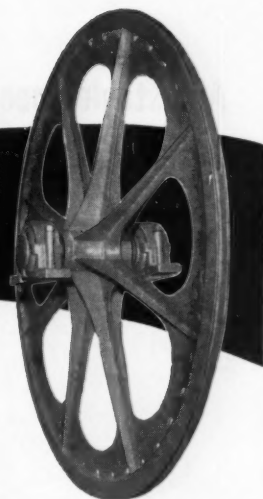
**THE "JETO"
BOTTOM DUMP SKIP**

- less dead load, greater pay load with light-weight aluminum and steel construction
- increased production with cleaner faster dumping action
- Lighter less expensive headframe construction due to greatly reduced headframe travel
- greater safety with positive dumping action and body safety latch



THE LOHED MINE CAR
(end cover removed)

- cleaner dumping, greater strength with rounded corners
- greater durability, easier maintenance with simple rugged all welded construction



**THE NEW
FABRICATED SHEAVE**

- reduces rope wear with anti-friction bearings and steel rim inserts
- less maintenance with quick changing rim inserts
- made of low carbon steel

Engineered for the rugged demands of metal mining!

For close to 100 years Lake Shore has focused its seasoned engineering attention on developing equipment to make metal mining operations more efficient and safer. Excellent results of that continuous effort are the "Jeto" bottom dump skip, the new fabricated sheave, and the all welded "Lohed" mine car; useful developments that have achieved increased production, lower maintenance costs, and longer equipment life for the metal mining industry. Write for detailed product bulletins.

LAKE SHORE Engineering Company

Iron Mountain 5, Mich.
Plants: Iron Mountain and
Marquette, Michigan

Branch Offices: Denver • Chicago • New York • Detroit • Phoenix
San Francisco • Milwaukee and Ishpeming

Underground cars • skips • cages • trestle cars • sheaves
grizzlies • snatch blocks • hoists • mills • special equipment

Adjustable-speed Gýrol Fluid Drive

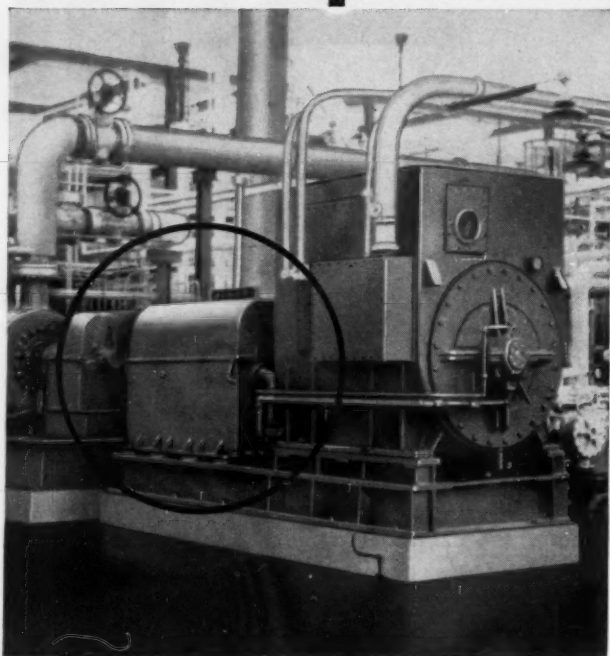


Photo courtesy Union Oil Co. of California

Unit shown is a 4000 hp, 1800 rpm, size 315, type VS, Class-6 Gýrol Fluid Drive equipped to automatically regulate the speed of a centrifugal compressor handling variable-density gases.

controls the flow in catalytic reforming processes

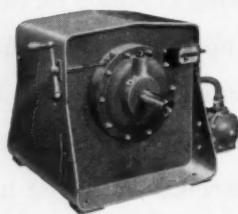
Accurate control of the flow of gases and fluids is the key to the successful operation of a catalytic reforming plant. Because its speed is *adjustable*, American Blower Gýrol Fluid Drives can vary the flow rates of compressors and pumps of all sizes and types — *as needed*. Consider these inherent advantages of Gýrol Fluid Drive:

- Provides infinite and accurate pump speed adjustment over a wide range
- Simplifies starting equipment — provides no-load starting
- Eliminates problem of "gumming" which may occur with mechanical dampering
- Saves steam needed for process work through use of squirrel-cage, constant-speed electric motor
- Permits automatic control. Flow rates can be automatically regulated by simple movement of one push-pull control rod

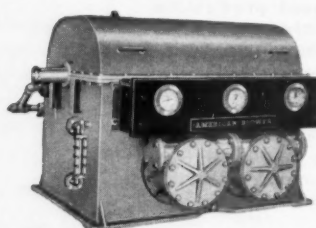
Whatever your method of catalytic reforming, use Gýrol Fluid Drives for flow-rate control. Call your nearest American Blower Branch Office for data.

Traction-type Fluid Drives

American Blower Type TM, traction-type fluid drives are also available as complete packaged units containing AC motor and built-in Gýrol Fluid Drive. Standard NEMA mounting bolt hole dimensions. 1 to 20 h.p.



Type VS, Class-2, adjustable-speed Gýrol Fluid Drive. Speed range: 5 to 1. Six sizes, 7½ to 800 hp; speeds to 1800 rpm.



Type VS, Class-6, Gýrol Fluid Drive. Adjustable-speed drive for compressors, pumps, and other high-speed applications. 200 to 12,000 hp; to 3600 rpm.

American Blower products serve the petroleum industry

- Air Conditioning, Heating, Ventilating Equipment
- Mechanical Draft Equipment
- Industrial Fans and Blowers
- Centrifugal Compressors
- Gýrol Fluid Drives

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

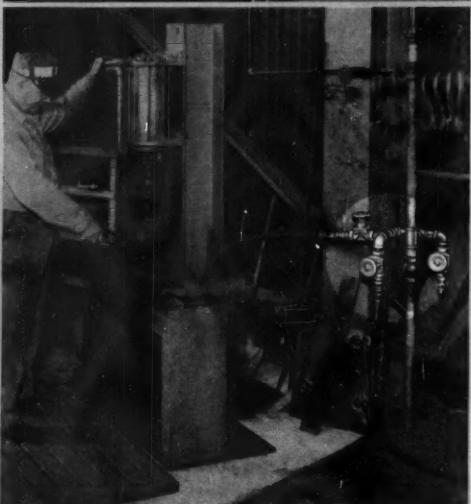


Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

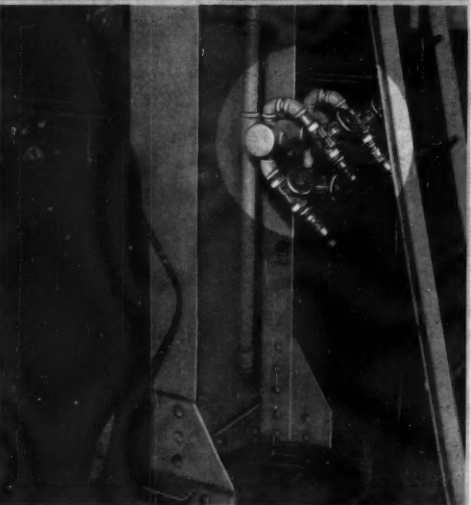
Hose outlets with quick coupling fittings attached to Grinnell-Saunders Valves at Lehigh Structural Steel Company.



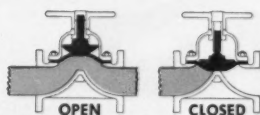
Outlet valves for this rod bender are Grinnell-Saunders.



4-outlet air manifold equipped with Grinnell-Saunders Valves.



"Lower air costs... increased productivity, with Grinnell-Saunders Diaphragm Valves"

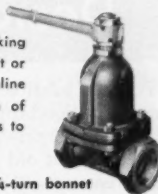


At Lehigh Structural Steel Company, compressed air now goes to work—not to waste. Upon discovering that a large percentage of its compressed air supply was being wasted through leakage, this Allentown, Pa. firm began a major review and overhaul of its entire system. The main cause of the trouble was found to be in the outlet valves which could not be kept in proper working condition.

To determine which type valve would stand up best under prevailing service conditions, a number of different valves were installed and the results compared. Based on these impartial "on-the-job" tests, Grinnell-Saunders Diaphragm Valves were approved—and were installed throughout the entire system.

Here is another instance of the economy of Grinnell-Saunders Diaphragm Valves... in use by more and more industries where low maintenance, long service, and complete dependability are demanded.

Features: complete isolation of working parts, leak-proof closure even with grit or scale in line, high lift for full streamline flow, freedom from clogging, choice of diaphragm materials and body linings to suit service, and easy maintenance.



QUICK-ACTING, 1/4-turn bonnet

GRINNELL

WHENEVER PIPING IS INVOLVED

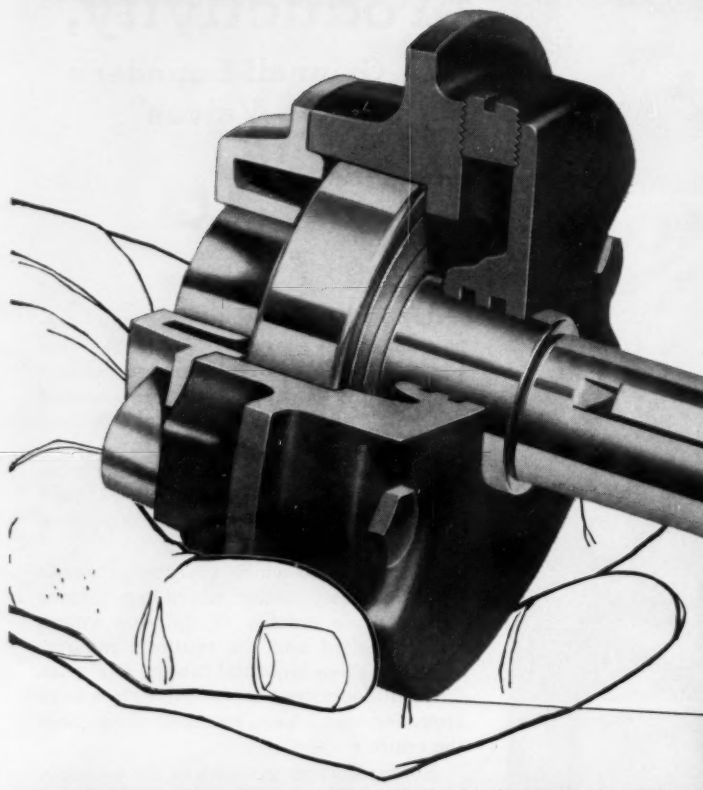


Grinnell Company, Inc., Providence, Rhode Island

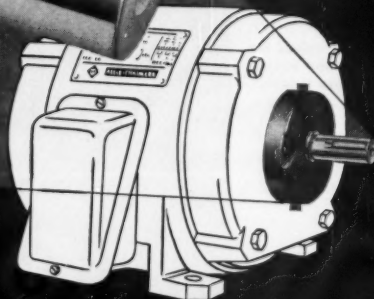
Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Here Is Extra Motor Value



Double-shielded bearing
Large grease reservoirs
Bolted-on bearing cap
Labyrinth seals



This Allis-Chalmers Bearing Design Gives More for Your Motor Dollar

You can lubricate these bearings without dismantling motor. Pipe-tapped holes in the bearing housings at two points provide means for inserting new grease, flushing out old grease and relieving pressure during re-greasing.

The bearing cap is held tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the

bearing against contamination from dirt and moisture.

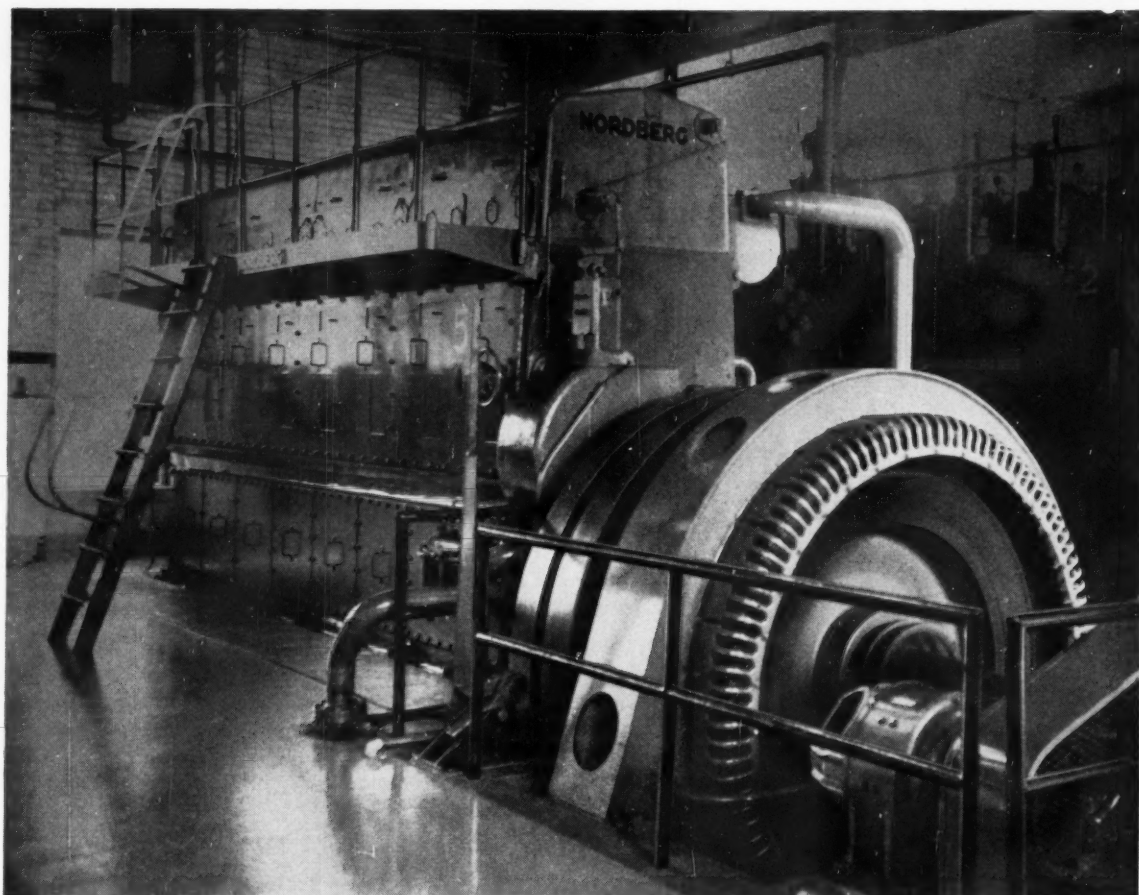
At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Look for the extra bolts on the end housing . . . the sign of greater value. Ask your Allis-Chalmers representative or Authorized Distributor to show you a cutaway section of this maintenance-cutting design. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B6210.

A-4617

ALLIS-CHALMERS





After 30,000 hours Koppers Piston Rings still maintain "excellent" compression

At the Neodesha Municipal Power Plant, Neodesha, Kansas, Koppers Piston Rings are an important part of the 1750 bhp. Nordberg Duafuel Engine illustrated above. After 30,000 hours of operation the pistons on this engine have never been pulled, and compression is still excellent. It is interesting to note that this Nordberg Engine, equipped with Koppers Piston Rings, has been in operation over 98% of the time—and carries

about 90% of the plant load.

Koppers has widely experienced engineers and extensive manufacturing facilities which combined can fill the most difficult of piston ring requirements. Next time you are concerned with piston rings or sealing rings, whether in replacement or new installations—in engines large or small—call on Koppers. Never any obligation, of course. For more information, mail coupon.



METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • Baltimore, Maryland
This Koppers Division also supplies industry with Fast's Couplings, Aeromaster Fans, Koppers Electrostatic Precipitators and Gas Apparatus.
Engineered Products Sold with Service

AMERICAN HAMMERED *Industrial Piston Rings*

KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 1611 Hamburg Street, Baltimore 3, Md.
Gentlemen: Please send me free 16-page booklet containing full information on Piston Rings.

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Company.....
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City.....Zone.....State.....

There's only one

GYRO-FLO

Ingersoll-Rand's Portable Rotary Compressor

INTRODUCED IN 1950

In 1950 the Gyro-Flo was absolutely new—a bold, forward, original idea in portable compressors. There was no other portable compressor like it.

Now, years of successful performance of thousands of units in all four sizes has established GYRO-FLO as the standard in portable compressors. This is affirmed by the ever-growing trend to rotary design.

Here there is no substitute for experience. Maintenance costs cannot be measured by one year's operation—or even two or three years'.

Each size must pass the test of time on the job. That's what GYRO-FLO has been doing since 1950. During this time all new, necessary features have been added so that GYRO-FLO is the best established rotary portable compressor now available.

When you purchase GYRO-FLO air power, you get today's most economical portable compressor. There is only one GYRO-FLO—and Ingersoll-Rand has made it since 1950.

Ingersoll-Rand, 11 Broadway, New York 4, New York



AVAILABLE IN FOUR SIZES

125 *cfm*

210 *cfm*

315 *cfm*

600 *cfm*



2-294



THERE'S AN EIMCO TO FIT YOUR LOADING JOB

There is an Eimco loader for your loading job. Small or large tunnels, drifts, slopes, inclines, haulage ways, overburden, cleanup, road building, clearing slides or any loading job that requires speed, economy and continuous operation with minimum machine attention.

Eimco loaders are available with wheels for rail type operation and crawler mounts for trackless work. They are self propelled by air,

electric and diesel motive power, depending on their type of application.

Eimcos are proved loaders — more of them are in daily use on hard rock mining jobs throughout the world than all other brands of mechanical loaders combined. Many of these have been in continuous operation for more than 20 years.

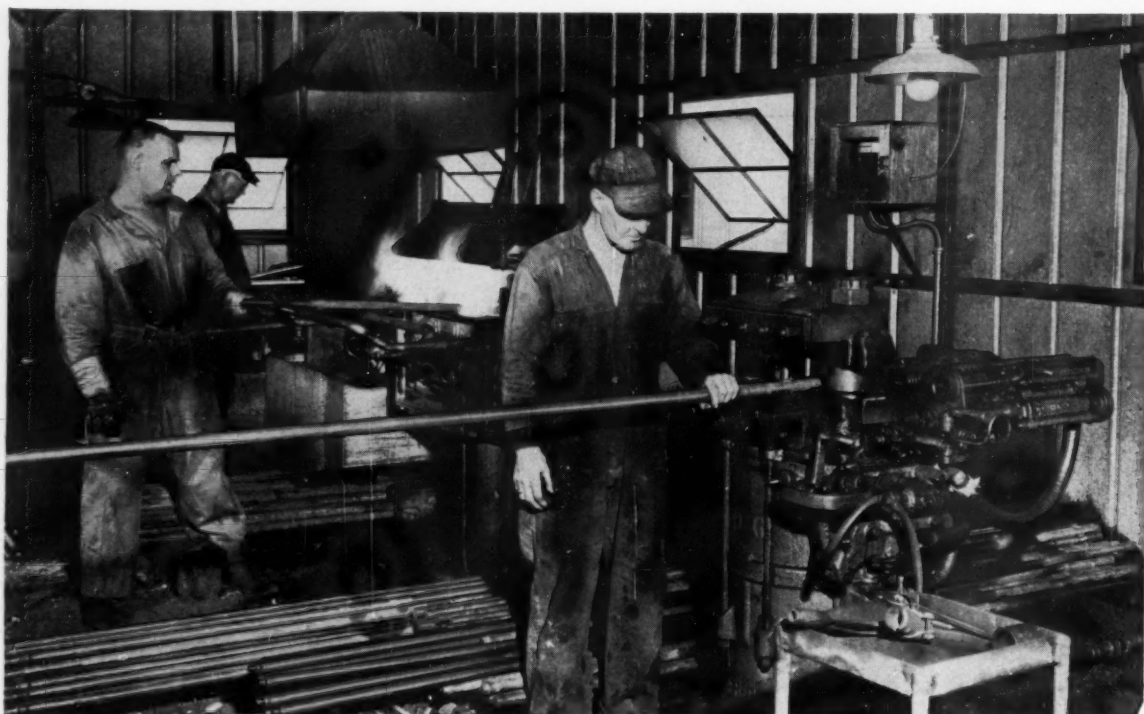
An Eimco is always your most economical loading machine. Write for details.

THE EIMCO CORPORATION
Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

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B-154



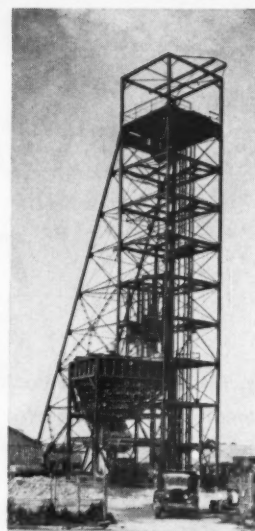
Blacksmith Billy Watkins shanking a Crucible Hollow Drill Rod.

they're using Crucible Hollow Drill Rods on the Boston Tunnel Jobs...

400-feet below the city of Boston, two seven-mile tunnels are being cut through solid rock. Replacing century-old mains, the tunnels will bring water from Quabbin Reservoir, 70 miles away, and remove drainage from the city.

On this job, like most other tough ones, Crucible Hollow Drill Rods are in daily use. For experienced construction men *know* they can depend upon Crucible Hollow Drill Rods for top performance at *lowest cost per foot of hole drilled*.

That's because they are made to *tool steel* standards by the nation's leading producer of *special steels*. So for extra dependability on *all* your drilling jobs specify Crucible Hollow Drill Rods. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 30, Pa.*



120-foot-high head frame used to raise and lower men and materials in excavation shaft. Morrison-Knudsen-Kiewit-Maney City Tunnel Extension Job, Boston, Mass.

CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America

COMPRESSOR FACTS ON INDUSTRY'S
MOST PREFERRED "POWER PACKAGE"



**FACT: The new Life-Line A is the most
weather-resistant motor on the market**

Whether your application is hot—cold—wet or dry, you'll find the new Westinghouse Life-Line® "A" motor will last longer under more extreme weather conditions than any other motor you can buy.

New insulation materials, housing designs, 4-way sealed bearings are tangible evidence of electrical, mechanical and lubrication system improvements that make Life-Line "A" industry's most preferred package of power.

Westinghouse builds a complete line of motors from 1 to 700 hp for compressor applications everywhere. Get all the facts by calling your Westinghouse sales engineer . . . *The Man With The Facts.*

J-21903

YOU CAN BE SURE...IF IT'S
Westinghouse



Best bet for better bids—

SPECIFY

GENERAL MOTORS DIESEL POWER

in all your construction equipment

You can *specify* General Motors Diesel power in over 750 different models of equipment built by over 150 manufacturers.

When you do you'll get fast-acting, quick-accelerating 2-cycle Diesel power that will help you do more work, faster, at less cost.

More work, because a General Motors Diesel is a "high torque" engine. And torque—as much as developed horsepower—measures an engine's working ability.

Faster work, because a GM 2-cycle Diesel, with its responsive governor, efficient fuel injectors and power at every piston downstroke, gives you instant pickup in response to changing loads.

Less cost, because a General Motors Diesel burns fewer gallons of safer, cheaper fuel. Also a GM Diesel costs less to buy and the parts cost less than for other Diesels of comparable ratings.

No matter where your contracts take you, you'll find GM Diesel distributors ready to supply fast service and quick delivery of low-cost factory parts. Check your local distributor today for full details on dependable, low-cost Diesel power for your equipment, or write direct for more information.



PURCHASED 23 GM DIESELS SINCE 1947

This LeTourneau-Westinghouse Tournapull is part of an earth-moving fleet used by the Lone Star Steel Company of Lone Star, Texas. The Company, one of the largest producers of steel in the Southwest, has been a consistent user of General Motors 2-cycle Diesel engines in several different kinds of earth-moving, construction and mining equipment for better than seven years.





SAVING \$170.00 A MONTH IN FUEL ALONE

United Construction Company cut fuel costs over 60% and reduced maintenance costs when they switched from gasoline to GM Diesel power on their Moretrench pumps. The GM Diesels worked 24 hours a day, 7 days a week—eliminated stops formerly required to pull and service spark plugs every three days and to replace them every three weeks.



13,000 HOURS—NO REPAIRS

General Contractor A. H. Famularo bought this GM Diesel-powered Northwest 25 Crane in April 1947. In 13,000 hours he never had an injector out, never touched the head or pan. He burns 16 gallons of low-cost Diesel fuel in 8 hours—specified GM Diesel power “because it was economical . . . and has proved to be reliable.”



25% MORE WORK; FUEL COSTS 1/3 LESS

Killough Construction Company has *standardized* on GM Diesel power for their portable rock crushing plant in Kansas. The firm uses six GM Diesels to run a hammer mill, operate conveyors and screens, a primary crusher and two shovels. One shovel, converted from gasoline to GM Diesel power, now does 25% more work on one-third less fuel cost.



“WONDERFUL PERFORMER”

This GM Diesel-powered scraper hauled nine yards every four minutes on a recent job for the R. J. Boe Construction Company. Contractor Russell Boe likes the “wonderful acceleration and trouble-free performance GM Diesel power gives me.” He says, “All you need to do is keep water, oil and clean fuel in that GM Diesel and you’ll get a good day’s work out of it.”

DETROIT DIESEL ENGINE DIVISION

GENERAL MOTORS • DETROIT 28, MICHIGAN

Single Engines . . . 30 to 300 H.P. • Multiple Units . . . Up to 893 H.P.

■
■
LARGE AREA BLAST CLEANING . . .

■
■
■
at minimum cost . . .



NORTON

BORON CARBIDE

■
■
JOB ILLUSTRATED . . .

**Cleaning welded section
of steam generation
plant condenser
prior to painting**

If you're blast cleaning large areas prior to painting — or cleaning small openings — there's a NORBIDE Pressure Blast Nozzle to give you maximum blast cleaning efficiency at minimum cost.

These rugged nozzles — lined with NORBIDE Boron Carbide, the hardest manufactured material commercially available — maintain stream contour and last hundreds of hours longer than any other nozzle made, eliminating expensive nozzle changing. Available with bores ranging from $\frac{1}{8}$ " to $\frac{7}{8}$ " with either flanged or threaded fittings.

Try 'em on your toughest blasting jobs. For full details, write for your free copy of Form 543.

NORTON COMPANY

41 New Bond Street, Worcester 6, Mass.

■
■
■
NORBIDE® . . . *The Longest Nozzle Life you can buy*

ON THE COVER

THE old mill in Sudbury, Mass., is a connecting link with the past. It exemplifies one of the first ways in which man harnessed Nature's power. Pioneer Americans depended on such mills for an important part of their food supply. Today we utilize waterpower more efficiently and on a much larger scale. Also, we have learned to convert the fossil fuels coal, oil and gas into kilowatts. Now we are on the threshold of a new era—of atomic power—and looking skyward in contemplation of solar-power development in the future. Natural power of some kind now does 95 percent of the work that once taxed men's muscles. The picturesque old grist mill started us on the road to more leisure and an easier existence.

IN THIS ISSUE

CAR-packed parking lots and traffic-jammed streets show plainly how most people travel and make it easy to understand why public transportation agencies are having a hard time. Some of them meet adversity by curtailing service; others, like the St. Louis Public Service Company, emulate the salmon and swim against the current. Our leading article tells how and why that concern is winning back lost customers.

WHEN it comes to roller bearings, The Timken Company really covers the waterfront. As the article starting on page 327 points out, it makes them in 27 types and 5850 sizes ranging in weight from ounces to tons. Regardless of the size, however, all are manufactured with great care and precision.

EVERYTHING that moves must overcome friction to keep going. Wherever two moving mechanical surfaces are in contact, some sort of lubrication is called for. Determining the most effective lubricant and providing and applying it constitute an exact science. The oilcan is definitely outmoded in industry. Some of the newer and better ways of doing its job involve the use of compressed air. Page 332.

IT TOOK man an even 50 years to dig a certain cement quarry in eastern Pennsylvania. Hurricane Diane opened her flood gates in August and filled it with water in just eight hours. Man then spent 47 days pumping it out. Page 338.

Compressed Air Magazine

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St. Louis Public Service
Company's Prize-winning
Maintenance Program Uses
Air Power Extensively for



KEEPING 1020 BUSES ON THE GO

WILLIAM H. GOTTLIEB

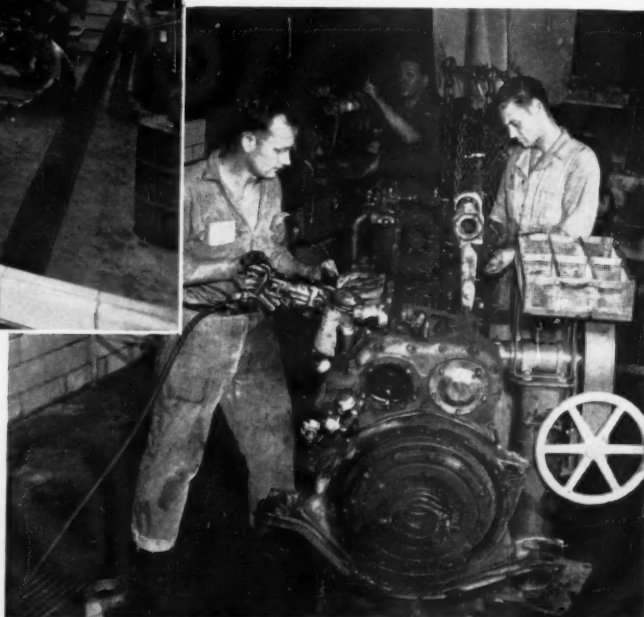
THE pressure is on the public transportation industry, and has been for the past ten years. In major city after major city the number of passengers carried per year by buses, streetcars and subways has been steadily decreasing, operating costs have been mounting and profits (if any) have been dwindling. Many big cities in the United States have come to expect public transit facilities to operate in the red.

The chief culprit in this decline has been the family automobile. Industry,



TEAR-DOWN ROOM

The general overhaul shop covers several city blocks. All heavy equipment coming into it for repairs from the five outlying garages is dismantled in the room pictured above. Each piece is lifted onto special cradles by either of two Ingersoll-Rand industrial air-motor hoists, one with a lifting capacity of 1000 pounds and the other of 6000 pounds. Two electric hoists serve as standbys. A closer view of some of the activity is shown at the right. A GMC diesel engine is being dismantled for inspection with the aid of an I-R Size S11 Impacttool. As every piece of equipment passes through this room, it could easily become a serious bottleneck. Fast-acting heavy-duty power tools help to prevent this.





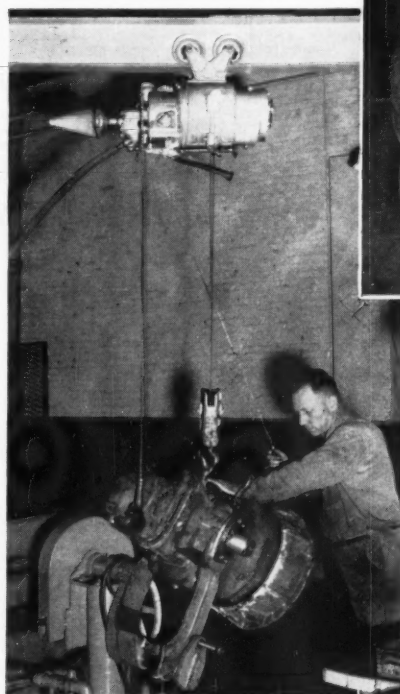
READY FOR ANOTHER DAY

Washed and vacuumed the night before, these GMC diesel buses (left) are only a few of the 1020 that are operated daily on 53 local routes, eleven express runs, three "Park-Ride" specials and two downtown loop routes.



EASING THE JOB

As the general overhaul shop handles all phases of bus maintenance except crankshaft grinding, impact wrenches are called upon to take care of a wide variety of assignments. One in the brake department is shown above running nuts on wheel lugs on dual tires. By suspending the wrench, the shop eliminates the last bit of tiring work from this heavy job.



PRECISION HOISTING

Bill Schewe of the turbine and differential section uses a 1000-pound air hoist to position a defective turbine in a special vise. By using Impacttools of two sizes to run off nuts of up to 1 1/4-inch thread size mechanics in this department can overhaul the rear end of a bus in not more than five or six hours. All 24 I-R air hoists in the overhaul shop are equipped with articulated-type ball-bearing mountings that are specially designed to carry the full load on four wheels.

showing a marked tendency to construct new plants in outlying traffic-free areas, has been no help. Free parking in company-owned lots encourages workers to join car pools and to shun public trans-

portation. Nor has the growing popularity of suburban shopping centers done anything to curtail the steady drop. An attractive combination of free parking, centralized stores and less congestion is winning housewives away from the habit of taking a bus downtown to overcrowded department stores. In short, statistics reveal a definite movement of both industry and population towards the suburbs, a movement that has added to the problems of public transit companies by making it easier for workers and shoppers to use their automobiles.

To win back lost passengers, many transportation companies are engaging in promotion campaigns. The main emphasis, however, has been on service. It is a fact that riding a bus, streetcar or subway train is cheaper than driving the family car. This is not too difficult to sell the man or woman in the street, who is well acquainted with the costs of gasoline, parking, depreciation and insurance. What the industry is seeking to

do, however, is to convince the public that transit is also a quicker, more dependable and more comfortable means of travel. To this end it is offering cleaner, more attractive equipment, coupled with limited-stop, more frequent schedules.

The St. Louis Public Service Company, of St. Louis, Mo., is a good example of what the industry as a whole is doing and can do to win back the lost passenger. Easily one of the most progressive transit companies in the country, as its record of postwar success testifies, it is offering the commuter express bus service, a fringe parking plan and many other new and attractive services. Briefly stated, the problem which it set out to solve in the years after the war was a 2-pronged one:

First, how to win back the worker and shopper who were using the family car in preference to public transportation; second, how to relieve the serious traffic situation which widespread use of the private automobile was causing in downtown St. Louis without forcing the city to spend large sums of money on thoroughways, widening streets and on the construction of costly parking facilities. This dual problem was the subject of a nation-wide competition sponsored by the Urban Land Institute in 1954, and the solution offered by John C. Baine, president of St. Louis Public Service, was selected as one of the best.

The company developed what it calls the "spotlight formula," which is based on the assumption that good transit service alone, regardless of schedule frequency, fare or advertising, will not do the job. The industry must be honest with the public. It must offer service that complements rather than replaces the family car. It must show the worker and shopper that it is smart to use the latter on some trips and smart to use public transit on others. Then it is up to the individual company to gear its service to eliminate as many as possible of those trips where the family car still has an advantage.

To do this, St. Louis Public Service now operates eleven different express routes in various sections of the city, catering particularly to rush-hour traffic, midday shoppers, baseball fans and summer opera patrons, as well as three "Park-Ride" runs where the commuter parks his car free of charge at the outskirts of town and takes a nonstop bus to his destination. To provide better transit coverage downtown, two loop routes are maintained. Also, shoppers are offered special reduced fares through the coöperation of downtown merchants who assume some of the cost. These spotlight services are in addition to regularly scheduled runs, which include 53 local routes.

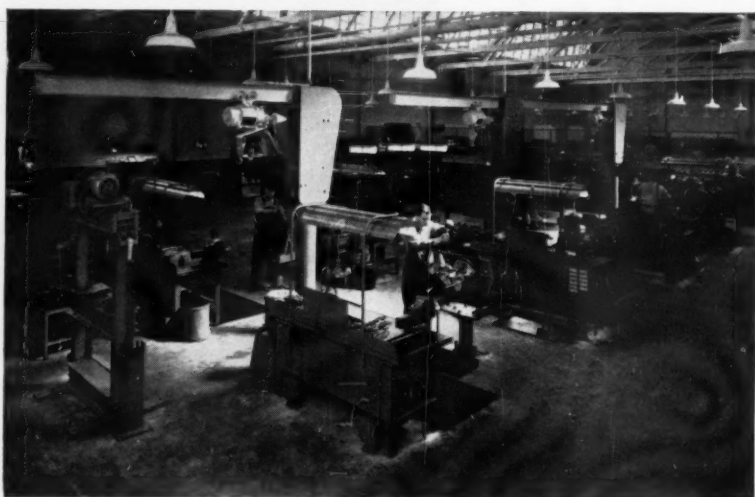
But the company does not stop here. Its fleet of 40- and 50-passenger General



Motors and Mack buses, almost all diesel-powered, are among the finest in the industry. The average age of the fleet is seven years; each bus is painted inside and out at least once every three years, and each is washed and vacuumed at the end of the day's operation. Maintenance—with emphasis on preventive maintenance—is serious business. It is closely tied in with the spotlight formula by providing passengers with the cleanest and most attractive buses possible; by helping to increase safety; by virtually eliminating breakdowns, a cause of major irritation to riders; and by effecting major cost savings. The company founded the industry's first comprehensive preventive maintenance program in 1928, and within three years had cut per-unit upkeep costs for the entire fleet by more than 34 percent.

For the past ten consecutive years the magazine *Bus Transportation* has declared that the automotive maintenance department of St. Louis Public Service is the most efficient and complete of its kind in the country among transit companies with more than 1000 buses in service. Its facilities consist of a centrally located general overhaul shop, five operating division garages, a small shop for utility trucks and a central equipment office.

At the five garages some 200 employees, working on a 24-hour schedule, handle all servicing, cleaning, inspecting, light repairing and dispatching for the fleet. At the end of each day the buses are refueled; oil, water and tires are checked; the vehicles are washed and vacuumed; and drivers make out formal reports citing unusual operating conditions. Mileage records are prepared at the garages at the end of every 1500, 3000, 9000 and 27,000 miles and controlled by clerks at the equipment office where files contain a complete history of all major equipment. Any defective unit



OVERHAUL FACILITIES

The overhaul shop has five separate bays. Shown at the top is No. 2 Bay, with the machine shop at the left and the engine-rebuilding area at the right. Heavy lifting in these sections is handled by eleven Ingersoll-Rand air hoists suspended from 360-degree swinging I-beam assemblies. Also in the same bay is the turbine and differential section (lower picture) where three I-R 1000-pound hoists are on duty. A mechanic in this section removes and replaces daily hundreds of bolts with the help of I-R Impacttools of two different sizes.

or part discovered as a result of these inspections, or on the strength of a driver's report, is sent to the general overhaul shop for repair. In addition, in order to catch a flaw before it can cause a service breakdown, engines, turbines, differentials and the like are removed and taken there after every 180,000 miles of operation.

The general overhaul shop covers an area of several city blocks and is divided into separate sections, including bays for body repair, metal fabrication and engine rebuilding, a machine shop, and departments for unit overhaul, electrical work, welding and painting. Insofar as possible, each section is arranged on a

production-line basis, with men skilled in different phases of the operations and with tools and facilities of a type and quality to promote best workmanship. For each mechanic there is an individual workbench equipped with an air hoist, power and hand tools and a compressed-air hose.

The production-line arrangement of the general overhaul shop was designed to move equipment through as quickly as possible without sacrificing attention to detail. In this way unit labor costs are reduced to a minimum and buses are kept rolling most of the time. This need for both speed and dependability is one reason for the widespread use of com-

pressed air throughout the shop. Air motors, with their simplified design and few working parts, stand up well under heavy-duty conditions. They can operate for extended periods at overload capacity without danger of burning out and require virtually no upkeep. For example, one of the 4000-pound-capacity Ingersoll-Rand air-motor hoists in the engine rebuilding department has been in continuous service for more than ten years without parts replacement or other maintenance. Installed in 1945, it has never been removed for any reason from its 360° swinging I-beam suspension.

Of the 35 power hoists in the shop 24 are operated by air motors and eleven are electric-driven. The latter are of 500 and 1000 pounds capacity and serve mainly as standbys on weekends and evenings when the big compressors are shut down. All the air hoists are Ingersoll-Rand units and vary in capacity from 1000 to 6000 pounds. They are suspended from swinging I-beam assemblies and travel on articulated-type ball-bearing trolley mountings which equalize the load on four wheels.

In addition to pneumatic hoists, air is used to operate tools, to blow dirt off equipment to be repaired and for paint spraying. The tools, also of the Ingersoll-Rand type, range from heavy-duty impact wrenches, capable of running nuts up to 1 1/4-inch thread size, to hammers,

riveters, sanders and small Multi-vane drills weighing less than 2 pounds and designed to drill 1/4-inch holes in steel. With such equipment, men can start work on a disabled bus in the morning; remove the engine, turbine and clutch; install a substitute engine plus all auxiliaries and have the fully repaired vehicle back in service by 4:30 that same evening in time for its regularly scheduled run.

Normally, all heavy units such as turbines, differentials and radiators arrive at the general overhaul shop by truck and are unloaded in the receiving department by a 2000-pound air hoist. Each is wheeled in a hand truck to the tear-down room, where it is lifted to a workbench or lowered into a special cradle either by a 1000- or 6000-pound air hoist. Two smaller electric hoists are installed as standbys in this department in which the equipment's history is checked. Riveted to it is a brass tag which carries its serial number, date of purchase and of its last overhaul. After this brief initial inspection covers are removed, the unit is again picked up by air hoist and sent to the shop's wash room.

Three important factors in good maintenance, according to St. Louis Public Service, are reliable tools, clean work clothes and a clean shop, which also means clean equipment. Give two identical engines, one coated with grease and grime and the other carefully cleaned, to two mechanics of equal skill, the one working on the clean machine will do a better repair job in less time. That's the reason why all equipment is sent to the shop's wash room before any work is done on it.

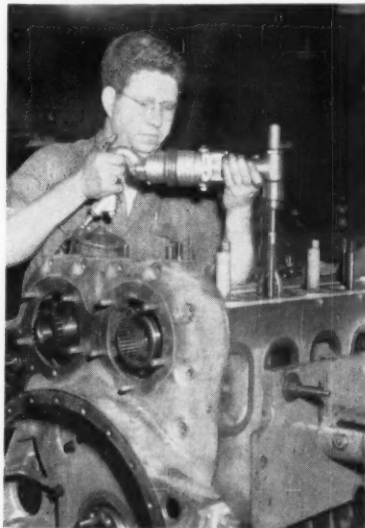
In the wash room are six air hoists: two of 2000 and four of 1000 pounds capacity. If the unit is to be immersed in one of two vats it is handled by a 2000-

pound hoist; if it is to be gone over by a steam gun it is suspended over a drain by one of the smaller units. All cleaning is done with a Wyandotte, Pennsylvanian or Macco solution, which is maintained at a temperature of 180°F. Fumes generated during the washing process are quickly removed through the ceiling by means of 10-hp exhaust fans.

Once the unit has been thoroughly cleaned it is sent back to the tear-down room, which is the hub of the entire shop and where the work load is always heavy because all incoming equipment must pass through it for inspection. There all parts are carefully checked for defects and wear and are channeled out to other sections for repair. Hundreds of nuts, bolts and studs have to be removed every day. For this reason the men are provided with three impact wrenches of different sizes to run nuts up to 5/8, 3/4, and 1 inch, respectively. In addition, air drills with wire-brush attachments are used to clean out carbon from cylinders and pistons.

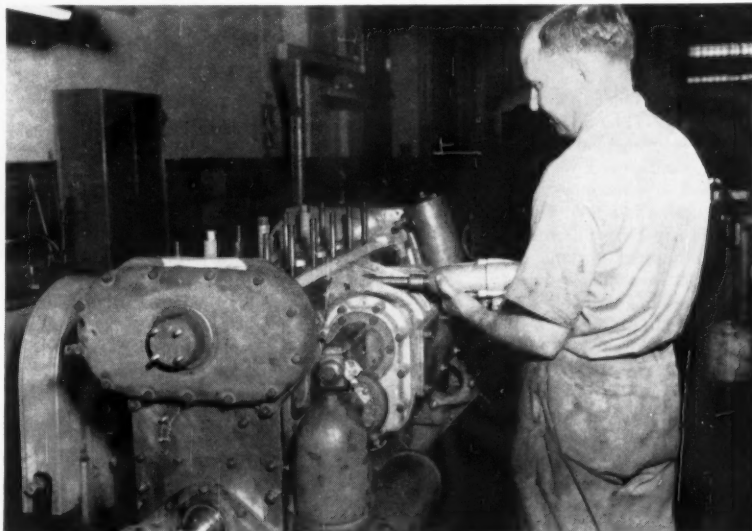
With these heavy-duty tools the inspectors are able to keep equipment moving to other departments at maximum speed. Ordinarily a GMC 671 diesel engine can be torn down completely in from nine to ten hours, with top speed as low as eight hours, while a GMC or Mack gasoline engine can be dismantled in from five to six hours. Original parts or necessary replacements are put in a tray, which travels with the block. Thus a man on the rebuild line gets the block and all its parts in orderly, convenient form.

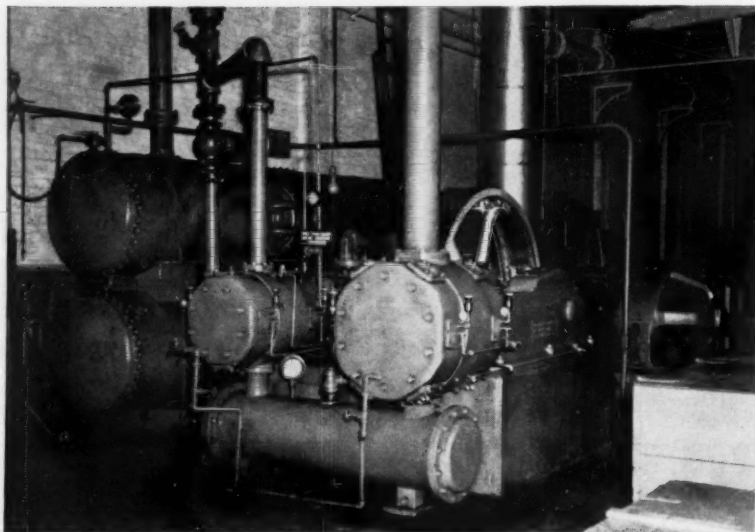
From the tear-down room the unit may go to any one of the following departments: engine rebuilding, cylinder block and head, fuel, turbine and differential, hydraulic and air, electrical, machine shop, radiator, brake, welding or salvage. In each one is kept a perma-



TOOLS OF DISTINCTION

Byron Barton, a mechanic in the engine-rebuilding section (right), is removing the blower nuts from a GMC diesel engine with an I-R Size 508 Impact tool. Each workbench in the department is equipped with one of these tools, as well as with a 4000-pound-capacity air hoist and a compressed-air cleaning line. Another pneumatic tool much in demand is the size 28M Multi-vane angle wrench shown above and being used by Manuel Greenwell to hone a cylinder.





ONE SOURCE OF AIR SUPPLY

Two Ingersoll-Rand compressors supply air for the general overhaul shop. One of them carries the normal load and the other one, shown here, helps out for an hour each afternoon and in emergencies. It has been in continual service since 1923 and was one of the first machines to be equipped with 5-step clearance control by means of which it automatically adjusts itself to the demand for air. It has a capacity of approximately 600 cfm and is belt driven by a 105-hp motor.

nent record of all repairs made, and this report is returned with the unit to the point of origin. It is subsequently filed in the central equipment office.

If an engine leaves the tear-down room, normal procedure is to send it first to the cylinder head and block department to be tested for leaks. There the engine block is lowered onto a special stand by an air hoist, and an impact wrench is used to remove the cylinder head and replace it with a head plate. The block is filled with water and carefully checked for leakage. At the completion of the test the impact wrench is again put to work to remove the head plate, and then the engine goes to the designated repair department.

By means of the facilities and equipment available in the overhaul shop a 50-passenger bus can be rebuilt there in its entirety. The only operation not performed is crankshaft grinding because so few shafts need regrinding that the high cost of a machine for that purpose would not be justified. Otherwise, everything from reboring a cylinder to straightening a bumper is done directly in the shop. At present it is handling salvage and rebuilding work for other transit companies in different parts of the country.

Major engine repairs are made in the engine rebuilding department and in the machine shop. In the former are five workbenches over each of which is a 4000-pound air hoist that often raises and lowers an entire engine assembly weighing more than 3000 pounds. To remove the countless bolts from cylin-

der heads, timing-gear covers and other parts, the men are equipped with individual Size 508 impact wrenches. In this way they spend less time on nut running and more on the precision work for which they have been trained. In addition, they are provided with riveting hammers and with angle wrenches which simplify the job of honing out cylinders and enable the operators to work in a normal position, thus preventing fatigue and increasing efficiency — particularly during late afternoon hours.

In the machine shop there are four lathes, the largest having a 24-inch swing and a 12-foot base; a Van Norman surface grinder, a Heald Company grinder, a Lempco piston grinder, a Barnes automatic honer for cylinder blocks and sleeves (bores and hones six cylinders in two hours), and a Weston Machinery radial drill for fly-cutting crankcases, boring out water holes in cylinder blocks and for other general drilling purposes. Suspended over each lathe is a 1000-pound air hoist.

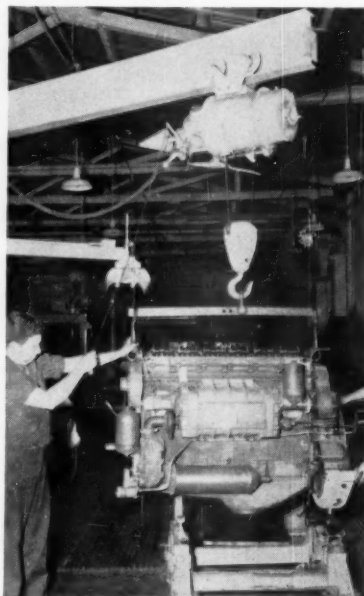
Heavy nut-running assignments are part of the daily job in the turbine and differential department where three 1000-pound air hoists do all the heavy lifting. On a single turbine there are more than 60 bolts of varying sizes that have to be removed and replaced during a routine overhaul, and this work, like elsewhere, is performed with air-powered impact wrenches to save valuable time and labor. The rear end of a modern bus can be completely overhauled in this section in a maximum of five hours.

Then there is the brake department

with two Lempco drum lathes and a pair of I-R impact wrenches to pull the big wheel lugs, and the body shop where compressed air is used to operate sanders, drills and riveters. Air outlets are available at all workbenches, as well as in the twelve pits that are designed for engine overhaul, change and service and provided with fluorescent lights, pipes which drain oil to an outside tank and with a blower to remove exhaust gas.

Compressed air for all tools and for general shop use is supplied at a cutoff pressure of 100 psi by two Ingersoll-Rand Type 10 compressors, one of which serves as a standby. The main unit is driven by a 150-hp motor and runs continuously from 7 A.M. to 4 P.M.; the standby starts at 3:30 P.M. and shuts down at 4:30 P.M. It is powered by a 105-hp motor.

This is just a capsule account of a large, complex shop, its varied equipment and organization. Several departments have barely been mentioned, some not at all. The purpose has been to outline the factors that make a prize-winning shop, to indicate the thoughtful planning and exacting supervision that enters into such an establishment and, finally, to describe the role of compressed air and pneumatic equipment in keeping St. Louis Public Service's 1020 buses worthy of the "spotlight."

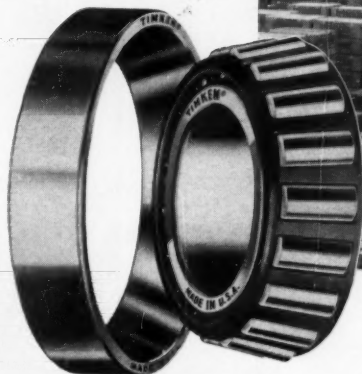


A JOB WELL DONE

A reconditioned diesel engine is lifted from its cradle by an Ingersoll-Rand 4000-pound air hoist. The latter has not been removed from its swinging I-beam suspension for any reason during ten years of service. Low-cost maintenance like this, coupled with fool-proof dependability, explains why compressed air is used so widely in this modern shop.

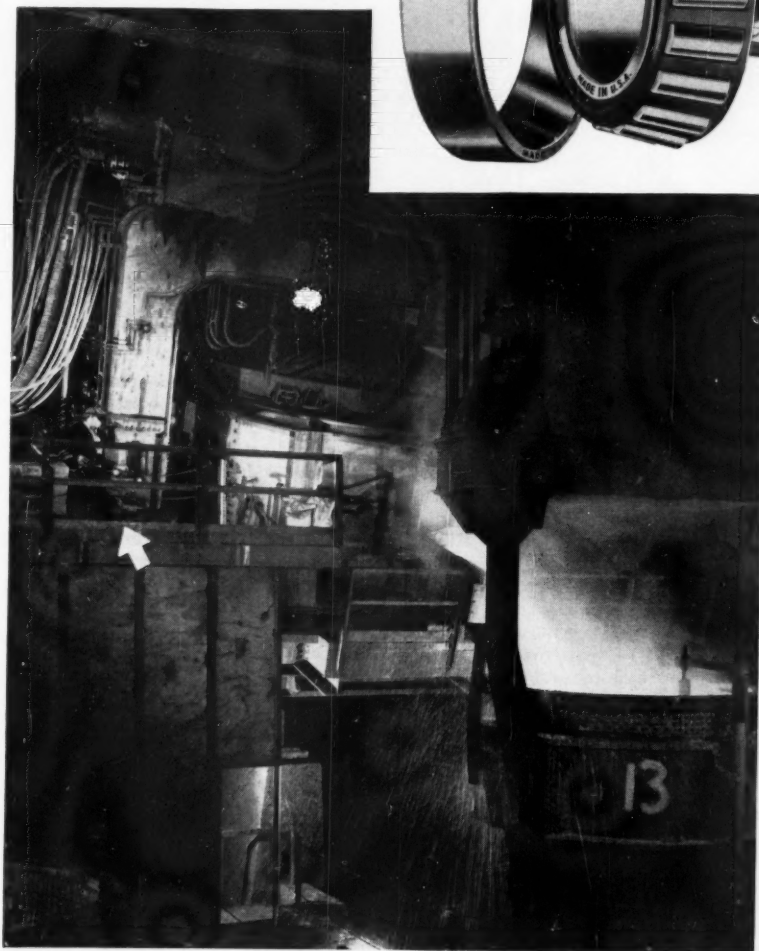
TIMKEN ROLLER BEARINGS

The Steel Must Be Right,
the Roller Taper Exact. The
Ohio Concern Mass Produces
Without Sacrificing Precision



PRECISION PRODUCT

Left—A standard single-row tapered roller bearing showing the cup or outer race on the left and the cone, rollers and cage on the right. From the shipping department (above) carefully packaged bearings travel near and far to take their places in varied types of machines and conveyances.



FROM HERE COMES SPECIAL STEEL

The company knows what kind of steel goes into its bearings because it makes its own. As the molten metal flows from an electric furnace into a ladle, the melter (arrow) checks it with an optical pyrometer.

THE Timken Roller Bearing Company of Canton, Ohio, has manufactured a complete line of tapered roller bearings for more than 55 years. Now suppose you were going to provide a bearing to ease the rotation of a wheel

or a shaft—a bearing that would virtually outlast the job it has to do, whose sturdiness would actually add to the life of the machine of which it is a part, one that other people could take for granted. One thing you would want to do is design

a bearing that would take all loads, regardless of the changing directions from which they might come. The second would be to produce it of materials so tough that it could stand up under those loads with practically no wear. And your third aim would be to construct it so accurately that it would turn out to be as ideal in fact as in theory. Let us design such a bearing.

Very little friction is present to impede the progress of a rolling object; only a little gravitational force will start it and keep it going. But an object that must rub instead of roll is confronted with a greatly increased impeding force of friction. What you want to do, then, is to get rid of as much of these rubbing motions as you can and replace them with rolling ones. If only one force at right angles to the axis of the bearing had to be considered, such as the dead weight which the bearing supports, straight rollers would be the answer. But the force acting on wheels and shafts rotating in everyday use is rarely, if ever, wholly axial or wholly radial. It is an ever-varying combination of dead weight and dynamic thrusts, bounces and lurches.

Timken bearings are designed to take radial and thrust loads separately or in any combination—they are designed with one geometric proposition in mind; that is, lines drawn coincident with all rolling surfaces must meet at a point somewhere along its axis. This point is determined by the angles of the rollers. The company produces 27 different types of tapered roller bearings in 5850 sizes. There are bearings with one row,



FIRST OR "GREEN" MACHINING OPERATION

Seen above are a few of the 4-spindle screw machines that make small- and intermediate-size cups and cones from seamless steel tubing. The other picture shows cold-heading machines that form small rollers.



two rows and four rows of rollers. There are bearings which will carry loads up to two million pounds at 500 revolutions per minute, and others which easily handle screaming speeds of many thousands of revolutions per minute. There are shallow-angle bearings for applications in which radial loads are the main factor, as well as steep-angle bearings for uses where thrust loads predominate over radial loads. But basically, the components of all of them are the cup or outer race, the cone or inner race, the tapered rollers which roll between the cup and cone, and the cage which bears no load and which does no work other than the light but important job of keeping the rollers spaced evenly around the peripheries of their raceways.

Just as important as the design and the components, when we are after bearings that other people can take for granted, are the materials of which they are produced. That's why the company manufactures its own electric-furnace steel—is the only one of its kind in the country that does this—and makes it nickel-rich to provide the toughness needed for long bearing life. It is thus able to control quality from melt shop to finished product.

The first operation in the "green" machining of bearing parts occurs in the single- and multiple-spindle high-production screw machines used to make the small- and intermediate-size cups and cones from seamless-steel tubing. Next, the workpieces are chamfered, the

identifying number is stamped on them and they undergo heat treatment. The following step is precision grinding. As the company believes that quality is put into the product at the machine, quality-control charts are used to make sure that the components are held within specified dimensional tolerances. Special indicator-type gauges have been developed by its engineers so that inspectors at the machines can continually check the parts and plot the resulting measurements on the charts. The operators interpret the information and make immediate machine adjustments, when necessary, thereby insuring a minimum loss of product.

Cups and cones that are more than 10½ inches in diameter are made from forged-steel rings, not from seamless tubing. They call for bigger, less automatic machines such as chucking lathes which rough out rings up to 1½ feet outside diameter. Cups, cones and rings as much as 6 feet across are rough turned and then finished on boring mills. These larger parts must be brought to size in two steps: first, they are rough cut and then, after inspection and tempering, are remounted on the boring mills for final turning. In the manufacture of rollers, the company is faced with the problem of a great variety of sizes. Small rollers up to 1½ inches in diameter by 2½ inches long are made on cold-heading machines, while those that may weigh as much as 32 pounds must be machined on turret lathes from solid bar stock.

The next step in production—heat treating—is one of the most important with respect to quality, for the bearings not only must have hard-wearing surfaces but also be able to withstand shock loads. To meet these rigid requirements the workpieces are first case-carburized and then hardened and tempered. If your steel is right in the first place—and if you make it yourself you know it is—then you can heat the machined parts to a controlled temperature and keep them in a carbon-containing atmosphere for a predetermined length of time so they will absorb carbon. A rapid quench in oil, and carburization is completed.

Each piece is then reheated for hardening. To prevent distortion of the larger sizes of cups and cones they are first centered in a hardening machine. Automatically, a pluglike fixture enters and engages the part to hold it in alignment while the sudden shock of an oil quench effects structure changes to produce a hard, wear-resistant surface and a softer but tough and shock-resistant core. In order to relieve stresses and brittleness created by oil-quenching hot steel the parts are tempered, usually in air, at about 350°F., and this finishes the heat-treating process. Any iron-oxide scale found on them is removed by shot-blasting because it would be detrimental to the work that follows.

Now comes the wizardry of grinding which imparts to the hardened surfaces a dimensional accuracy and surface smoothness almost impossible to com-



CARBURIZING DEPARTMENT

In these retort furnaces bearing parts absorb carbon from an atmosphere containing that element.

prehend. On cones and cups, the first operation is grinding the faces until they are parallel and an exact distance apart. In the case of small sizes the work, once again, is performed rapidly and automatically, while larger ones call for bigger, semiautomatic machines which grind one face at a time. The inside diameter of a cup is the tapered, outer raceway of a bearing; therefore the grinding of its surface is a critical job. To insure quality, techniques are employed to control the stand (the equivalent measurement of size), taper, runout, surface finish and visual characteristics. Machines vary in type and volume of production with the size and kind of parts handled, but the objective is invariably the same—incredible accuracy.

Cone bores which are not tapered are ground on equipment much like that used in grinding the inside diameter of cups. Next the cone ribs are ground on machines designed by the company. The rib adds the mechanical feature of positive alignment. It is with this surface the large ends of the rollers come in contact as they move between the raceways. After that the cones receive their prescribed outside diameter. Here, again, quality control is rigidly maintained.

Meanwhile, on other grinders, rollers by the millions are being brought to the same smooth, dimensionally exact finish, some slowly and painstakingly, others at twinkling high production rates but still painstakingly, for no matter what the method or size of the roller the taper must be exact and the surface must be right to make bearings that other people can take for granted.

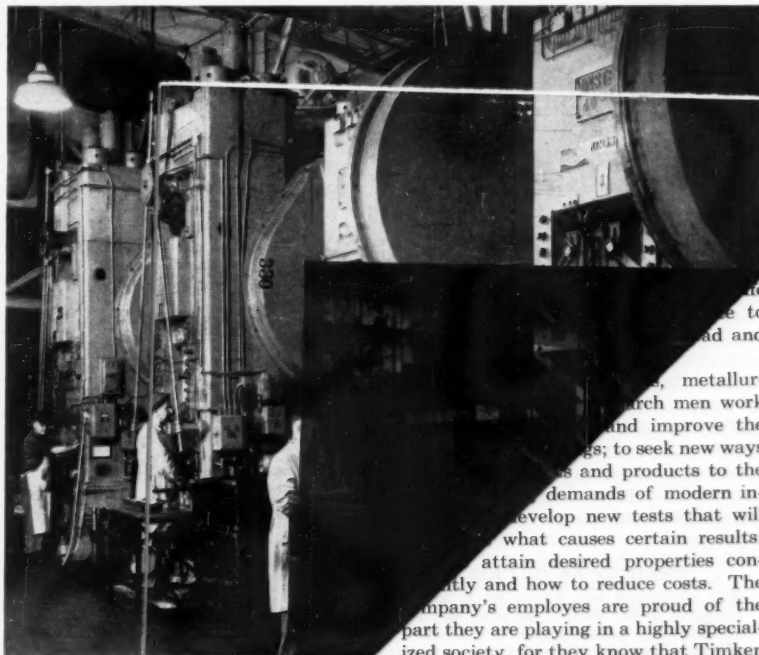
Parts for the larger bearings go

through the same basic grinding operations as the smaller ones. The huge machines in the special finishing department at Canton, Ohio, are capable of handling products up to 6 feet in diameter while holding dimensions to a tolerance that may be as small as two thousandths of an inch. Bearing surfaces of the smal-

ler parts are finish-ground to approximately 25 microinches. If bearings could be given absolutely smooth surfaces, their races and rollers would be ground to zero microinches. To make them as smooth as possible, they are honed until their surface finish measures within 2 to 8 microinches. (The Timken Company uses the Profilometer to measure the surface finish of bearing parts.) Bearing cages, which position each roller around the cone, are stamped from strip steel on presses ranging in capacity from 45 to 800 tons. The processes through which these parts go include blanking, sizing, perforating, winging, annealing, spreading and finally phosphating for protection against rust.

There is one more point to consider in our production story, and once again it deals with the great variety of sizes of bearing components. Completed and flawless, rollers of any one size will not differ in diameter more than a thousandth of an inch. But that is far too much. So in a special machine, with an uncanny power to split a thousandth of an inch into many parts, the rollers are sorted into groups in which the variation in diameter may be as small as 125 millionths of an inch. Rollers in any one set are then ready to share their work equally when assembled in a bearing. Cones, too, are sorted into size groups for matching with rollers on gauging machines.

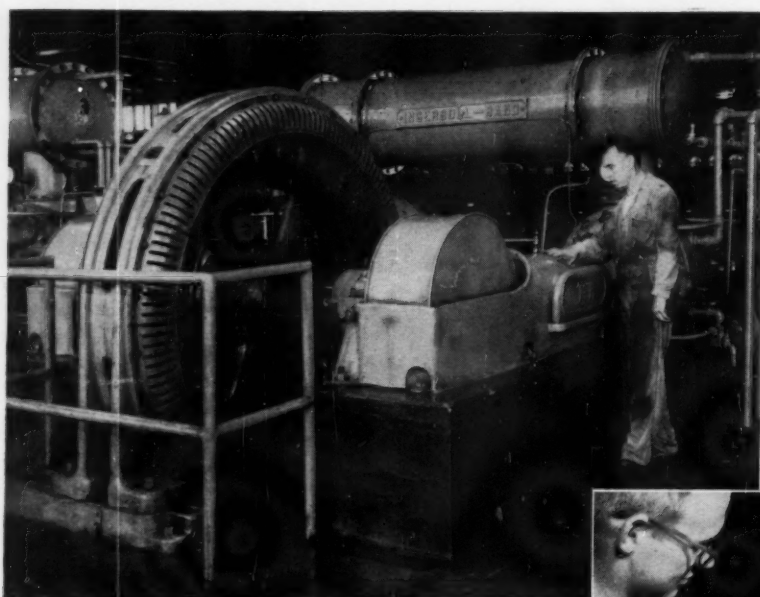
Now we arrive at the inspection, assembling and shipping operations. In



POWER

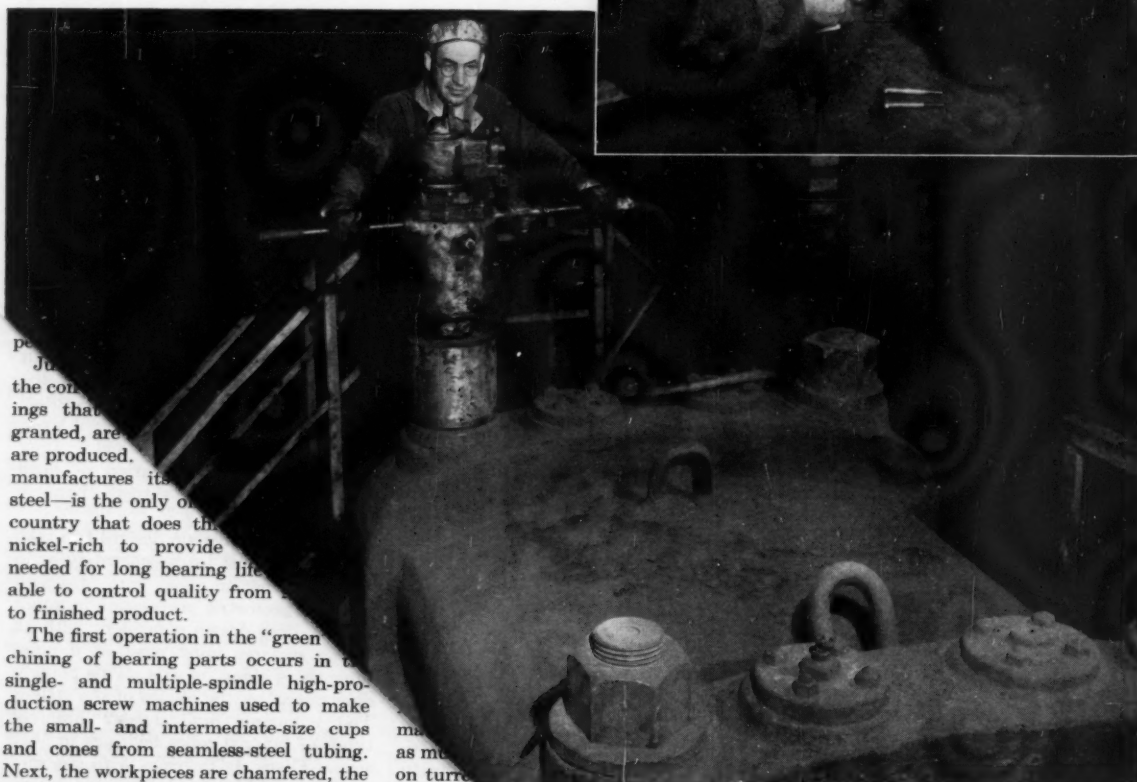
Some of the big machines that do the blanking, sizing, perforating, and spreading to form an

metallurgical research men work to improve the quality of the products to the demands of modern industry. They develop new tests that will show what causes certain results; they determine how to attain desired properties consistently and how to reduce costs. The company's employees are proud of the part they are playing in a highly specialized society, for they know that Timken tapered roller bearings met the requirements of the "machine age" and will meet the more rigid conditions of the "jet age."



AIR POWER DOES ITS PART

Like all modern industrial concerns, the company uses air power in many ways. Both the bearing factory and steel mill at Canton, Ohio, are supplied with compressed air by five large machines like the one shown above. Whenever the 35-inch blooming mill in the steel plant has to be opened, an Ingersoll-Rand Size 588 Impactool (below) saves valuable time in loosening and tightening the large nuts on the retaining bolts. A smaller Impactool (right) aids in maintaining electric motors in the steel plant.

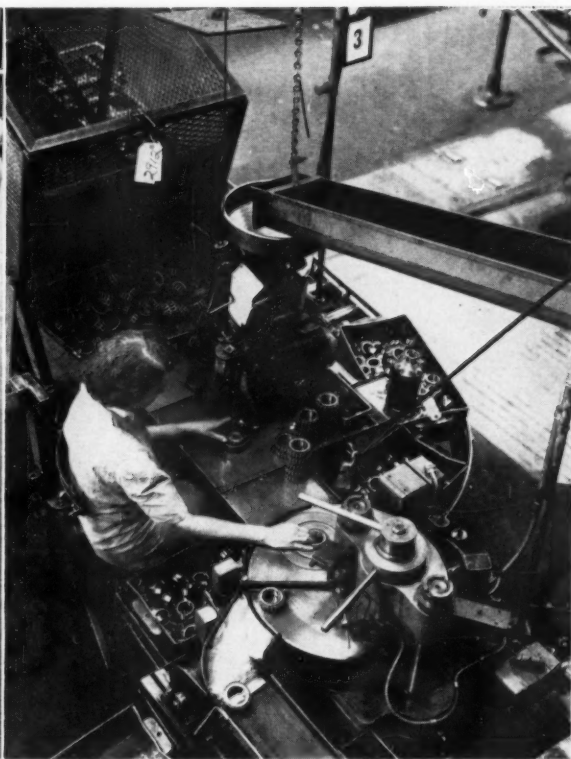


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granted, are
are produced.
manufactures its
steel—is the only one
country that does this
nickel-rich to provide
needed for long bearing life
able to control quality from
to finished product.

The first operation in the "green"
chining of bearing parts occurs in the
single- and multiple-spindle high-pro-
duction screw machines used to make
the small- and intermediate-size cups
and cones from seamless-steel tubing.
Next, the workpieces are chamfered, the

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the finishing and inspection depart-
ments, cups, cones and rollers are visual-
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gauged as to critical dimensions. To pass
inspection each cup must be within the
tolerances specified for stand and taper
measured on specially designed gauges
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that done visually. Rollers are inspected
on company-designed machines on which
they are automatically positioned in a
circular spider. As the latter moves the
rollers from left to right, a dial under-
neath it turns counterclockwise and



rotates the rollers, thus permitting the inspector to see the entire surface of each one.

In the fastest assembly operation for small bearings, rollers are cleverly turned large end up as they enter the home stretch. The assembler positions a cage on a fixture and the machine automatically puts one roller in each pocket. Then the operator places a cone inside the cage of rollers and transfers the unit to a press which closes-in the cage so that the assembly can't fall apart. The work is finally washed, greased and packed automatically.

Of course mill-size bearings are examined, assembled and packed under quite different conditions than the automotive-size type. Inspecting and gauging a roll-neck bearing, for example, is a delicate proposition even though the completed product may weigh as much as 4 tons. The rollers are first positioned around the cone and between two cage rings by means of cage pins with pipe threads on the bottom end which engage and lock in the tapped hole of the lower ring. The driven end of the pin protrudes above the upper ring and is welded into place. The diameter of the hole through the rollers is several thousandths of an inch larger than that of the pin to enable the roller to rotate freely. The finished bearing is thoroughly coated with oil or grease before being packed for shipping.

This, then, is how Timken tapered

SORTING AND ASSEMBLING

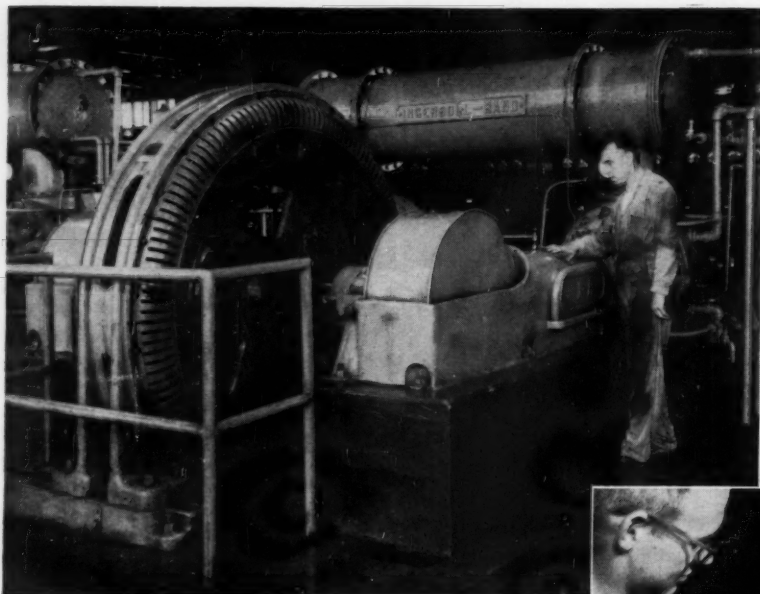
The machines shown at the left split a thousandth of an inch into many parts and sort the rollers into groups in which the maximum variation in diameter may be as little as 125 millionths of an inch. Automatic machines like the one pictured at the right assemble bearings of small and intermediate sizes. The operator is filling a cage with rollers with her left hand while the right one moves an assembled cone to the closing-in press. Her right arm has interrupted an electric-eye beam that automatically indexes the press, discharging completed assemblies onto the conveyor in the foreground.

roller bearings are manufactured from scrap metal to end product. The story would not be complete, however, without a further word about the company's efforts to maintain its long-standing reputation for bearings of unsurpassed quality. Precision tools and gauges are needed to turn out a precision product like roller bearings, and in the main tool room at Canton are the lathes, milling machines, drill presses, shapers and grinders used in making them. In grinding master gauges, the toolmakers work to limits of fifty-millionths of an inch. The precision gauge laboratory, which is equipped with some of the best American, Swiss, German, Swedish, and English measuring instruments, inspects everything done in the toolroom. Angles may be checked to an accuracy of one second of an arc. If two straight lines, each one mile long, were made to form an

angle of one second of an arc they would be approximately 5/16 inch apart at the open end. This department is kept at a constant temperature of 68°F, and humidity is maintained at a percentage least conducive to rust.

Before production starts, research and development work is necessary. During the course of manufacture testing goes on continually to see if the raw material is up to standard, if the steel is being made properly, if it is of the correct hardness and structure and if it is being machined to the best advantage. After the bearing is completed it must be tested to find out whether it is qualified for its purpose and to determine its life in service as well as its resistance to special conditions such as overload and fatigue.

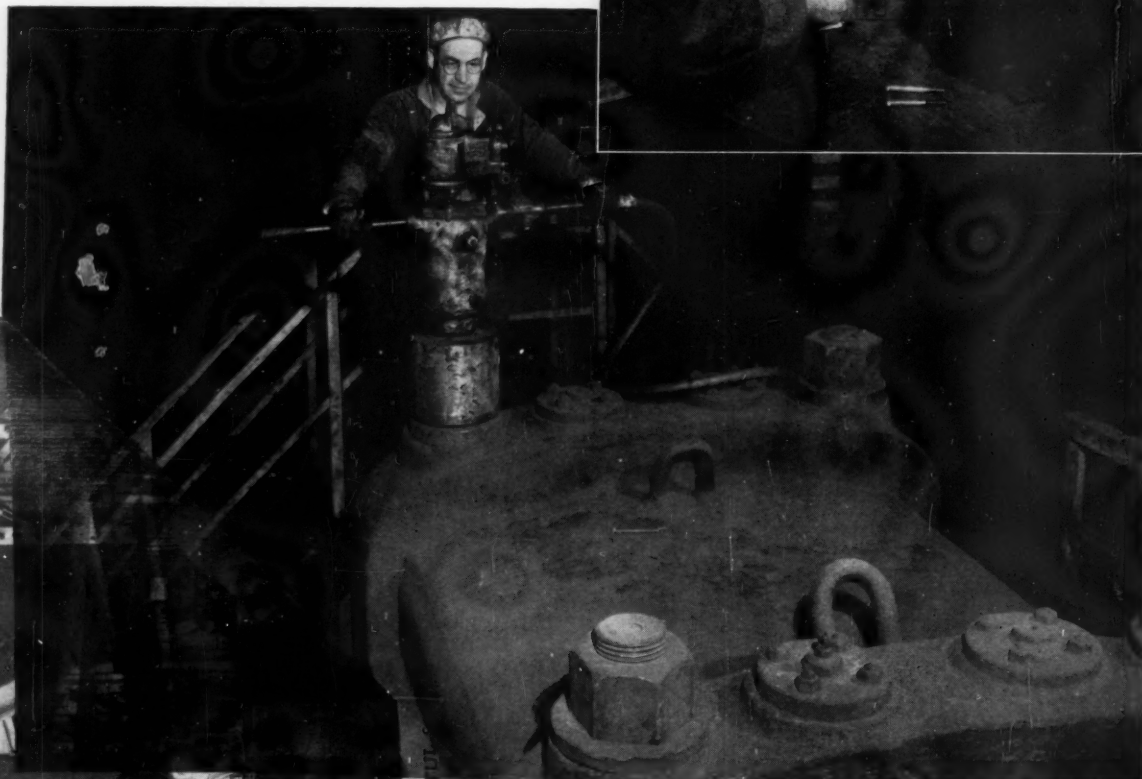
Highly trained chemists, metallurgists, engineers and research men work steadily to maintain and improve the quality of the bearings; to seek new ways to adapt materials and products to the ever-increasing demands of modern industry; to develop new tests that will show just what causes certain results; how to attain desired properties consistently and how to reduce costs. The company's employees are proud of the part they are playing in a highly specialized society, for they know that Timken tapered roller bearings met the requirements of the "machine age" and will meet the more rigid conditions of the "jet age."



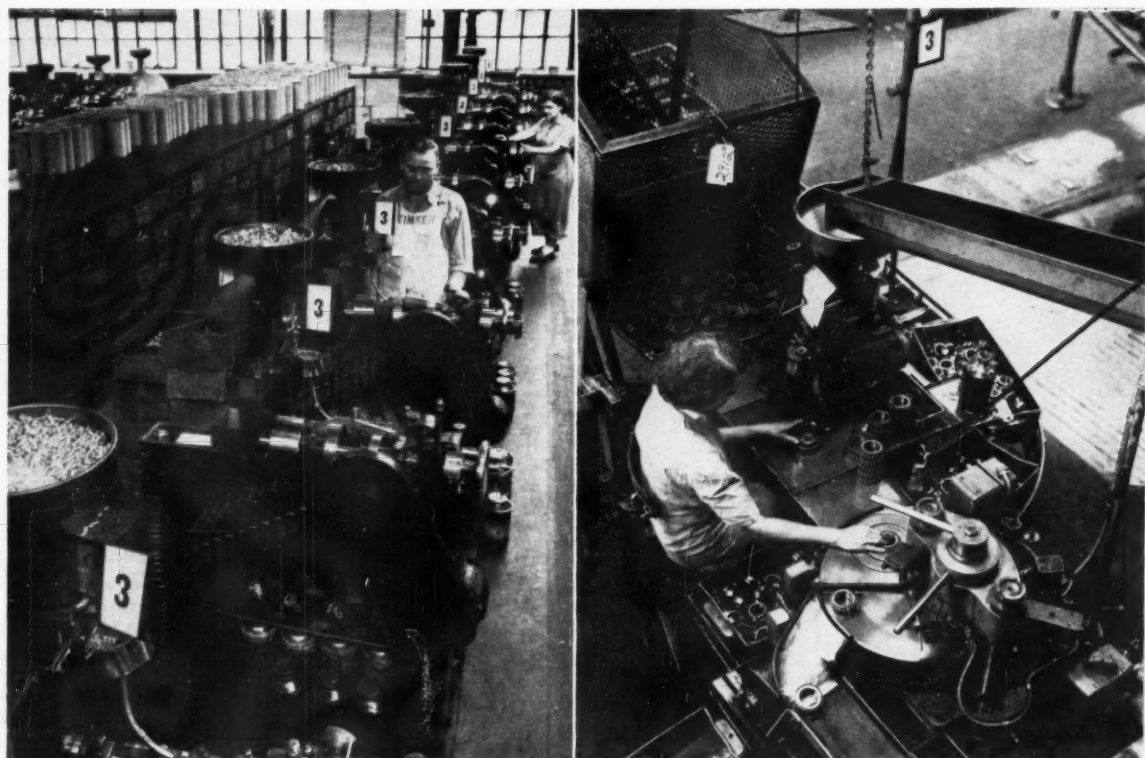
the finishing and inspection departments, cups, cones and rollers are visually examined for surface defects and gauged as to critical dimensions. To pass inspection each cup must be within the tolerances specified for stand and taper measured on specially designed gauges and each cone gauged for proper bore tolerance. The company employs the physically handicapped whenever possible, and several blind persons are now inspecting cups for dimensions with electronic sound devices. It has found that the quality of their work is as high as that done visually. Rollers are inspected on company-designed machines on which they are automatically positioned in a circular spider. As the latter moves the rollers from left to right, a dial underneath it turns counterclockwise and

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POWERFUL
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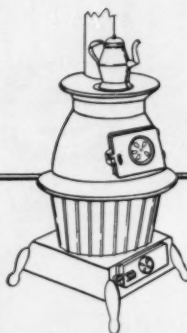
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OILING THE WHEELS OF INDUSTRY



Compressed Air Has Had a Hand
In the Advancement of
Lubrication from the Tallow
Pot to an Exact Science

R. J. NEMMERS



LINCOLN ENGINEERING COMPANY

END OF AN ERA

A collection of oilcans taken from the automatic screw-machine department of a Detroit industrial plant when a central lubricating system was put in. Also shown are some of the damaged bearings that had to be replaced because hand oiling was inadequate.

FRICITION often has been called a necessary evil. Without it there would be no life as we know it. Learning to live with it, however, has been one of man's tougher tasks and has given rise to the big lubrication industry. With today's higher machine speeds and wider extremes of temperature and other variables, proper lubrication presents problems almost unheard of only a few years ago, and not the least of them is the means of applying oils and greases effectively.

No era of recorded history fails to show signs of the use of some kind of antifriction material. It is probable that animal fat, vegetable oil or even mud was applied to grease skids long before the invention of the wheel. An Egyptian tomb of the 1400 B.C. era opened by archeologists of our day contained a chariot on the axle of which there still remained some lubricant. Although it was

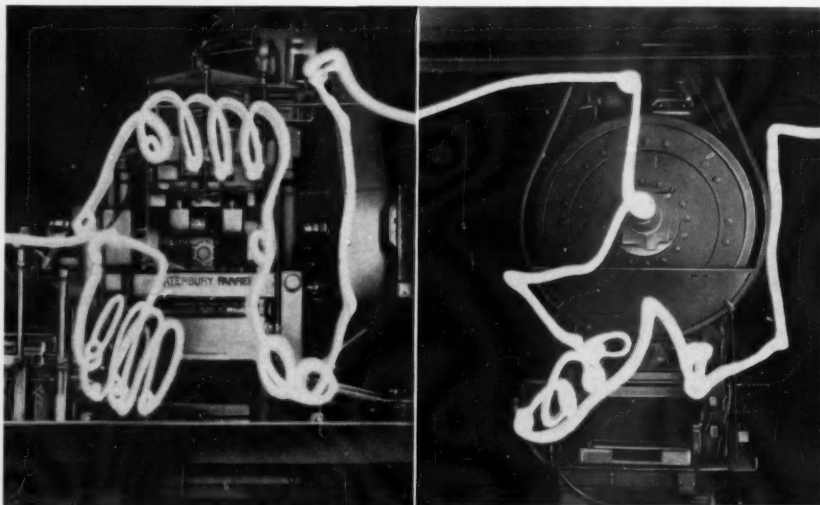
greatly decomposed, chemists who analyzed it thought that it might be either beef or mutton tallow. Pliny (A.D. 23-79) compiled a list of lubricants which included most of the naturally obtainable ones with which we are familiar, even some derived from petroleum tars. According to that list, those early people must have known that heavy and light

lubricants have different applications.

It is strongly suspected, however, that ancient lubricating practices were haphazard. Indeed, hit-and-miss methods extended right up to the first years of the industrial revolution and into the twentieth century in some cases. Inadequate lubrication is common in industry even today. However, "lubes" and tools with which to do the job and do it properly are available, and seldom is there a really good excuse for faulty lubrication.

An early treatise, believed to have been published shortly after steam engines were first successfully applied, gives a good idea of what was known about their lubrication and prevailing practices at the start of the industrial revolution. Even a cursory glance at some of the details causes one to wonder that the machine age ever arrived. The section dealing with oiling was appended to the main text almost as though it were an afterthought, and advised the opera-

LINCOLN ENGINEERING COMPANY



TRAIL OF AN OILCAN

The white line was traced by a light strapped to the wrist of an oiler as he lubricated a punch press at General Electric Company's Schenectady works. It took him eighteen minutes to visit the 62 points that required lubrication. An automatic centralized system now does the job in 45 seconds and never skips or forgets.

tor to "find an old tea pot or similar receptacle and fill it with tallow obtained from the butcher." Then it went on to say that he should "place the pot someplace on the engine where there is sufficient heat to keep it liquid," and followed with the instruction to "have an apprentice engineman or helper pour some of the tallow on all rubbing surfaces from time to time." The engineer was evidently left to his own devices as to how to get the tallow into the cylinders and other hard-to-reach places. It is significant, however, that James Watt's earliest engine patents did include complete specifications on lubrication and that his designs embodied a type of force-feed oil system.

The changes made since then have had one objective: to devise something to take the place of the apprentice and his tea pot; to make sure that all "rubbing surfaces" receive the correct amount of lubricant rather than an unspecified quantity at irregular intervals. Proper oiling depends on getting the right lubricant onto the right surfaces at the right time and in the right amount. It is not our purpose here to describe proper lubes other than to say that they should be of the required viscosity and other physical characteristics. Most manufacturers recommend specific oils or greases for their equipment, and lubrication engineers of the various oil companies also are available to help in choosing those most suitable for given purposes.

Lubrication can be defined as a substitution process. When oils are used, their lower fluid friction values are substituted for the higher friction of solid surfaces; when solid or semisolid lubes are used, their lower coefficients of solid friction are likewise substituted for other higher values. Thus, as we know, it is necessary to interpose the lubricant between contacting surfaces (the right place) if it is to do its intended job. The



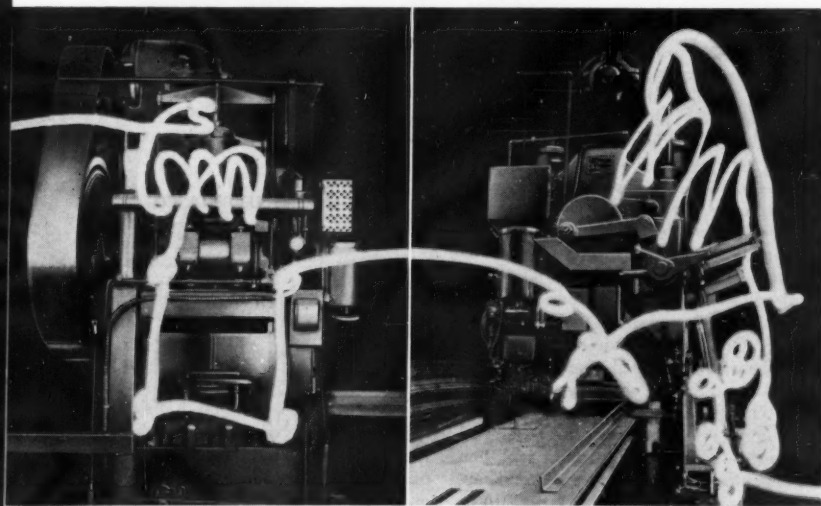
LUBRICATING VALVES

Proper lubrication prolongs and improves valve service. Illustrated is equipment developed for the purpose by the Nordstrom Valve Division of Rockwell Manufacturing Company. A compressor mounted on the truck furnishes air for operating the pump in the foreground that forces grease through the hose to fittings at the valves. Conventional automobile greasing systems work on the same principle.

latter requirement would pose a more serious problem than it already does were it not a characteristic of oils and greases to form a film on journal bearings and between flat surfaces moving in touch with each other. This fact is explained by the so-called fluid-film theory which is based on the property of lubricants to adhere tenaciously to a surface. In many cases oils are especially compounded to give them even a higher than normal degree of that quality. Known as extreme-pressure (EP) oils, they can form and maintain films under extremely heavy loads.

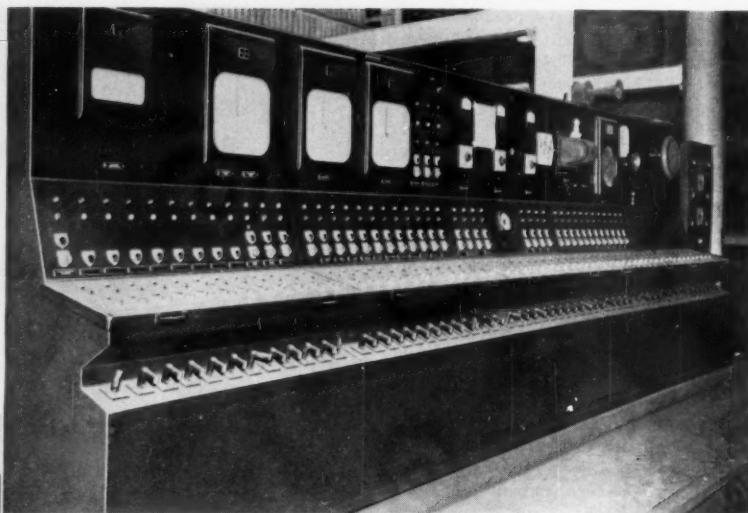
Putting the right amount of oil on a bearing surface at the right time has been the toughest of all problems. It is apparent that a large quantity applied, say, but once a shift is not nearly so effective as smaller amounts put on several times in that period. Similarly, still less lubricant will do an even better job if applied continually. Also, it can be shown that an oversupply of oil on bearings, particularly those of the ball and roller type, as well as on slideways may result in added friction caused by the lube itself. (Journal bearings have a built-in "regulator"; they can take at one time only enough oil to fill the clearance space between the shaft and the bearings.) The bad effects of an undersupply of oil—that is, galling, wear, and even gross seizure—are well known.

Compressed air has turned out to be a valuable helper in putting lubricants where they belong, and the remainder of this article will deal with lubricating devices which make use of air power. Generally, modern systems of this type may be broken down into three groups according to the way in which air is used. Each group may be further classified as to the degree of automation and whether operation is continuous or intermittent. All, however, come under the head of centralized lubrication (known in the trade simply as CL), a practice that is growing rapidly. Centralized systems, as the name implies, are those that serve to oil similar bearings, an entire machine, or even many machines from a single reservoir and are generally automatically



ROBOT OILER

At the Hanna Coal Company's preparation plant near Adena, Ohio, lubricant is supplied to a wide assortment of bearings on both cleaning and processing equipment from three pumping stations (one is illustrated below) through 18,000 feet of supply lines. The station includes a time-clock controller, low-level and line-rupture alarms, a recording pressure indicator and air-powered pumps. The master control panel at the right governs the operations of all three stations and includes cycle recorders, red warning lights indicating any deviation from normal service and other recording indicators. In systems of this type there is no chance of the lubricant becoming contaminated; it is pumped directly from the barrels in which it is received.



LINCOLN ENGINEERING COMPANY

controlled from a central station. Or several systems, perhaps using different lubes, may be regulated from a group control panel.

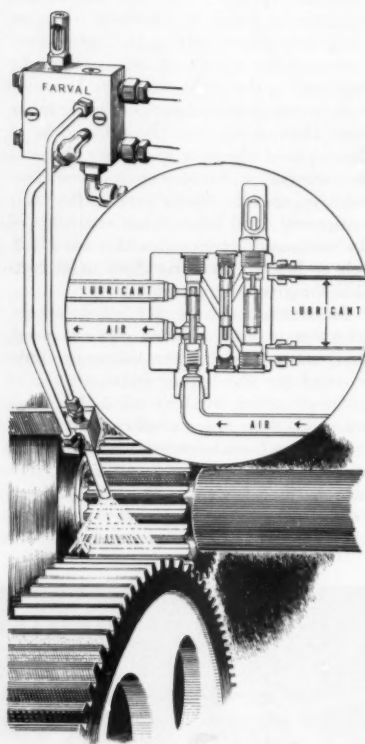
Basically, CL devices replace hand oilers of yesteryear, and because they function mechanically are not subject to "forgetfulness." Once set in operation, they will deliver a measured amount of lubricant, neither too little nor too much. And so long as they are kept in good repair and their reservoirs are replenished the vital job of lubrication is performed properly and without the need of oilers putting their hands and arms between fast-moving parts or shutting down a machine. Furthermore, CL systems frequently do the work at considerable savings in labor charges and lubricant and power consumption. Costs incident to downtime, maintenance, repair parts, etc., likewise are much reduced.

The first lubricator of the pneumatic type may be compared to a paint-spray device. Compressed air and lubricant are delivered by separate lines to a nozzle which directs the atomized oil against the proper surfaces. The method also lends itself readily to spraying certain of

the lighter-bodied greases and, while suitable for a wide range of applications, finds its greatest use in oiling open gears and slides.

Generally, a spray unit works intermittently: in the case of slow-moving open gearing it may operate once during a timed interval that corresponds to what is slightly more or less than a complete revolution of the gear so as to lubricate a different section of it each time. Or it may go into action once every 10 or even 100 revolutions, depending on the speed, the continually varying mating surfaces of different-sized gears spreading lube over all the teeth. In the case of slides, the spray device is generally set to function at the end of a stroke and to lubricate the surface immediately in front of the traveling member, thus letting it carry oil or grease across the entire plane. One application of continuous spray-lubrication should be noted, and that is the oiling of some types of high-speed chain drives.

Usually, spray systems are designed to operate automatically; that is, when the machine they serve is turned on they, too, are ready to go to work and do so



AIR-SPRAY LUBRICATOR

Lubricant is led to the Farval dispensing unit through two lines. The plunger (below the sight feed glass in the circle) supplies a measured amount of oil from first one and then the other line as it reciprocates. This action is synchronized with the opening of the air valve to spray the lubricant.

whenever the control point on the machine cycle with which they are synchronized comes around. Spraying uses less oil than full-flood lubrication, is more easily regulated to bring about optimum

conditions and, needless to say, is much more reliable than hand oiling. One of the accompanying illustrations shows a representative spray unit.

Another compressed-air spray lubricator should be mentioned separately because it differs so much from those discussed that it might cause confusion. In design it is much like any such device, but it is generally operated manually and used "permanently" to lubricate with graphite or other solid compound certain types of conveyor chains that pass through high-temperature ovens or furnaces. The graphite is in colloidal suspension, usually in water, and applied in that manner to insure complete coverage and evenness of coating.

In its simplest form, the oldest air-powered lubricating system merely exerts pressure directly against the surface of a lubricant in a reservoir to move and force it into bearings. More complicated (mechanical) devices have an intervening piston arrangement which, more often than not, also serves to multiply the pressure on the lubricant stream. (Some of today's higher-pressure systems operate with 100 psi in the air section and up to 4000 psi in the lubricant section.) In either case, this type may be called an air-pressurized system. It is the one most familiar to laymen because it is used to grease automobiles, and in that service is of course manually controlled. But recently a new method has been developed by which motor vehicles with air brakes can be automatically lubricated.

The latter device, which does away with almost all hand oiling and greasing of motor transport trucks, is called a Multi-Luber and makes use of an air cylinder each time the brakes are applied to force a measured amount of lubricant to the many different places on a truck or trailer that require oiling. Since braking depends on service conditions, this centralized system insures a protective film wherever and whenever needed, no matter whether the brakes are used only a few times or often during a run. The unit is designed so that one

broken feeder line will not interfere with the proper lubrication of all the other points. It has a reservoir capacity sufficient for about 7500 miles of normal service, or about one month's operation.

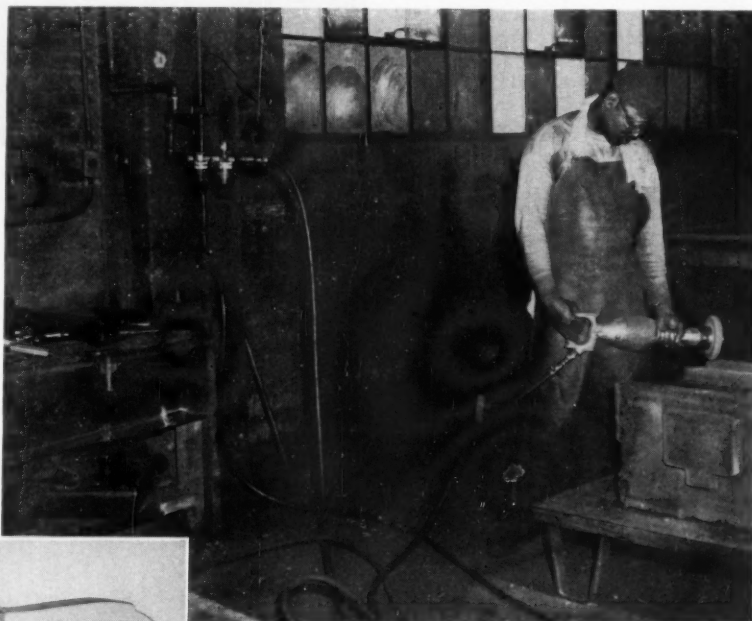
A variation of the Multi-Luber has been developed for fork-lift trucks and is mechanically controlled either by the operator or through the action of some moving member of the vehicle. In another type, known as the CentrOmatic, bearings are connected to manifolds of force-feed injector valves which, in turn, are connected to a common header terminating in a readily accessible fitting on the outside of the truck. Then, when the bearings require lubrication, an oil feed line from an air-operated pump is attached and all are greased in one easy operation. The adjustable injector manifolds are designed so that all bearings get the proper amount of lube; loosely fitting ones cannot "hog" all the oil and "starve" tighter ones.

Air-pressurized units, both mobile and stationary, are available for many different types of machines. They may be equipped with timing mechanisms to actuate them at intervals ranging from a

few minutes to several hours; some mechanical device on the machine itself can be made to trip valves admitting air to the system; or they may be controlled by the machine operator through manual valves. Built-in safety devices either set off an alarm or stop the machine when the air supply fails, when the reservoir is empty or when an oil supply line is damaged, broken or clogged.

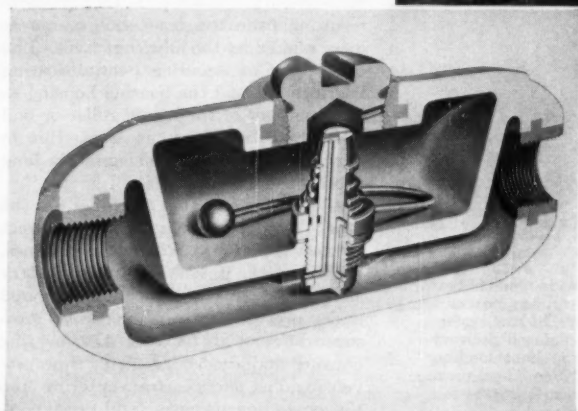
In still another type of air-powered device the air serves to atomize the oil and then to convey it to the point of use. One of its principal applications is that of lubricating pneumatic tools, rock drills, air cylinders, motors, etc. In such cases oiling is entirely automatic: turning on the air supply to operate the equipment starts the lubricator (provided it contains oil), and because it works only when a tool or drill is running no oil is wasted.

Most units of this kind depend on siphoning or aspiration to draw the lube from the reservoir into the air stream, where the velocity of the air breaks up the oil into a mist or fog. When the air expands in the tool the mist particles are deposited on the working surfaces. Lu-



OIL-FOG LUBRICATION

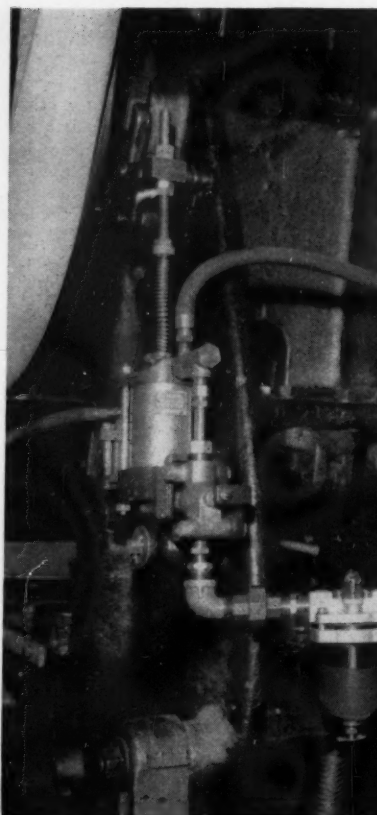
In the Norgren Micro-Fog lubricator compressed air atomizes the oil, which is then carried through the air line into the Ingersoll-Rand grinder pictured above. The lubricator is installed alongside a companion separator on the wall. The amount of oil fed into the line can be determined by a sight feed glass and is easily adjusted over a wide range. Where conditions do not favor a permanent installation (as in the case of rock drills), or where sturdier equipment is required, users may choose a lubricator of the type shown in section at the left. It is cast of lightweight aluminum and is designed to work in any position. A product of Ingersoll-Rand Company, the device stores oil in the upper chamber and meters it through a small orifice into the air passage. The oil feed is powered by the slight differential in pressure between the inlet and outlet when air is flowing. When air is not being used no oil is fed.



bricators of this type must be carefully designed to make sure that the oil droplets are fine enough to be carried to the tool (not deposited in hose or piping) but not so minute as to pass through the tool and be exhausted with the spent air.

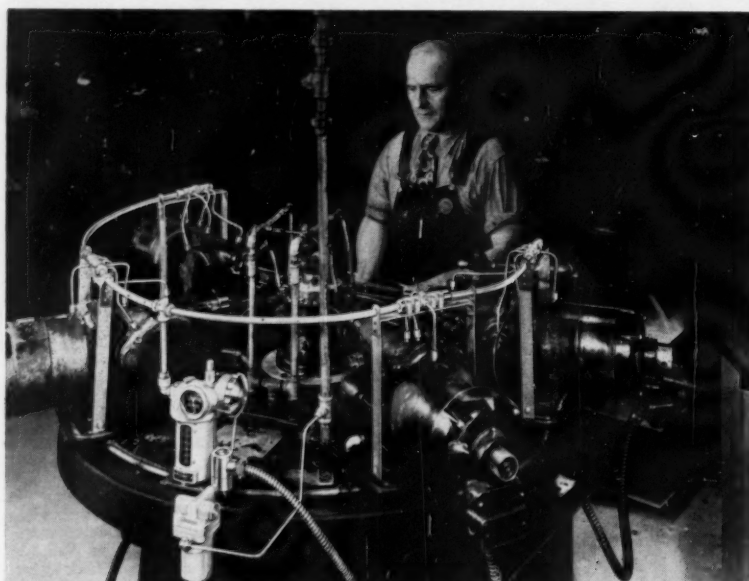
Although many pneumatic tools have built-in lubricators, the capacity of the latter is generally small because of space and weight limitations. As a result, most tool manufacturers recommend the use of a separate air-line lubricator, the selection depending primarily on service conditions. For example, in a factory where permanent installations are feasible, where individual tools do not demand much air and lubricators are not abused, a small unit including a separator is usually chosen. As a rule, it will have a transparent reservoir for readily checking the oil supply. But for work out-of-doors, in mines, or where lubricators are much abused, a larger-capacity device of cast metal is often specified. The latter is generally coupled into the hose line and constructed to operate in any position.

In recent years oil-fog lubrication has received increasing attention for other than air-powered equipment, and the principle on which the units are based has been modified to permit their application to all types of bearings and bearing surfaces. Essentially of the same design as those described, the main difference is that the air used is lower in



SCHRADER LUBRICATOR

This is the lubricating system for an air-actuated clutch mechanism on a power press. The cylinders and valves (center-left) cycle about 30 times a minute. In the lower-center and right is a Schrader combination filter-lubricator that supplies oil to the working parts of the pneumatic controls. Interposed between the filter and the lubricator is a pressure regulator that controls the reactive force on the clutch.



REACHING MANY POINTS

The term centralized lubrication may refer either to a plantwide system that lubricates several different machines or to one that lubricates all the bearings on one machine. The latter type is shown here. It is an Alemite Oil-Mist system serving a multiple-head Kingsbury drilling machine. Note the main oil delivery line running around most of the machine and the smaller drop lines leading to individual bearings. Units of this type operate on air at from 10- to 30-psi pressure and generally have sufficient reservoir capacity to last for at least one full shift's work.

pressure (usually between 10 and 30 psi) than that supplied to most pneumatic tools, which ranges from 90 to 100 psi. Such high pressure is not required to atomize the oil, and of course lower pressure results in a saving in air consumption. Also, in place of the hose or pipe that conveys air to a pneumatic tool, lubricating tubes or pipes are needed to deliver the mist to the respective bearings.

Oil mist or fog is said to be especially suitable for lubricating ball and roller bearings. As was pointed out earlier, anti-friction bearings can get too much oil or grease; any surplus just causes a measurable rise in the total friction value resulting from the resistance to movement offered by the lubricant itself. The usual way of avoiding overlubricating bearings is to fill the bearing housing so that one-half of the lowest roller or ball is covered—no more, no less. But in most cases that condition cannot be long maintained.

A properly adjusted fog luber, on the other hand, can supply the correct amount of oil to the bearings at all times. Furthermore, it has several secondary advantages. As the lubricant is delivered under pressure there is a positive pressure differential between the bearing housing and the atmosphere, thus preventing dust particles from entering, and the expanding air has an additional cool-

ing effect on the bearing. One unit will serve many different bearings, provided they all require the same oil. Just as in the case of other types, the oil-mist lubricator can be adapted for full or semi-automatic control, and it operates continually. It is said to result in savings exceeding the cost of the air used.

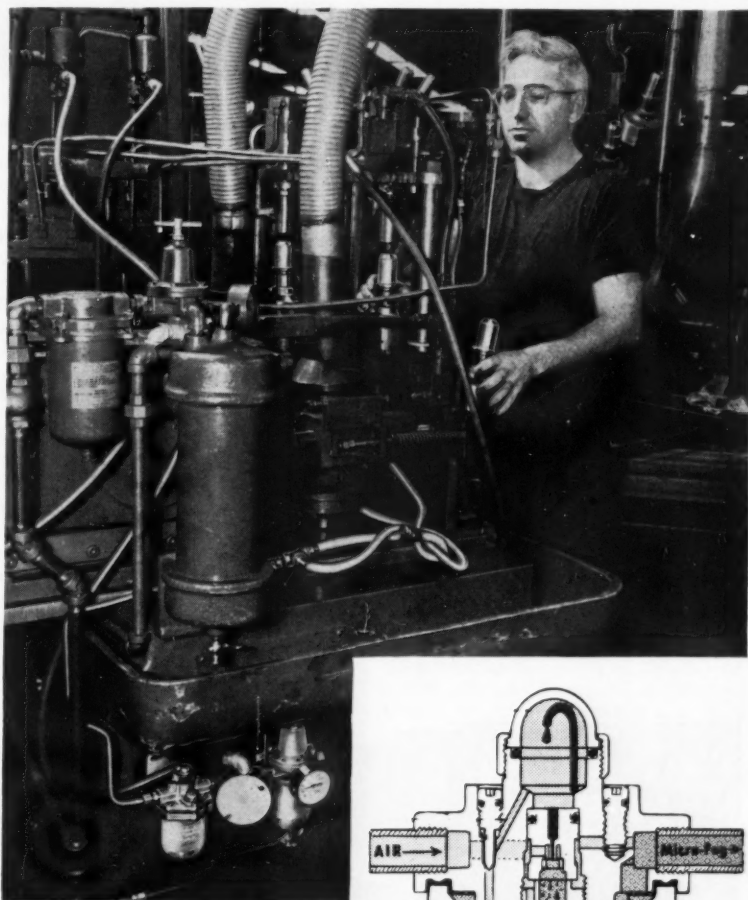
Special adapters or fittings make it possible to adjust fog or mist systems to meet a wide variety of lubricating demands. One fitting serves to condense oil out of suspension so that it can be applied in liquid form, and another converts the fog into a spray. (Sometimes neither is necessary for antifriction bearings because the turbulent conditions within the housings of certain high-speed bearings cause the tiny particles of lubricant to collide and coalesce to form larger droplets.) In a properly designed system there must be no restrictions in the lines that would cause premature condensation of the oil. In addition, the lubricator should be the low point in the system so that condensed fluid will always drain back to it. Most oils are suitable for fog or mist units, but greases compounded with graphite, soaps or inert fillers should not be used.

Of course there are many types that do not require compressed air for their operation. Some of these are also classified as CL systems, and common among them is the lubricator used on air-compressor cylinders and similar equipment. One make, which is illustrated, obtains its power from some moving part of the compressor, usually the crankshaft. The device embodies a rotating shaft on which are mounted a varying number of cams. Each of these drives a small plunger, which forces a metered amount of oil into its supply line and thus to the cylinder. The latter type came into general use in the 1920's and is believed to be one of the first completely automatic and centralized systems to be offered as standard equipment on any machine. Even so it was a long time before it was applied to any significant number of compressors.

Today, it is estimated that only 15 percent of the machinery in service is provided with up-to-date lubing systems, leaving most of America's machines without the benefit of automatic

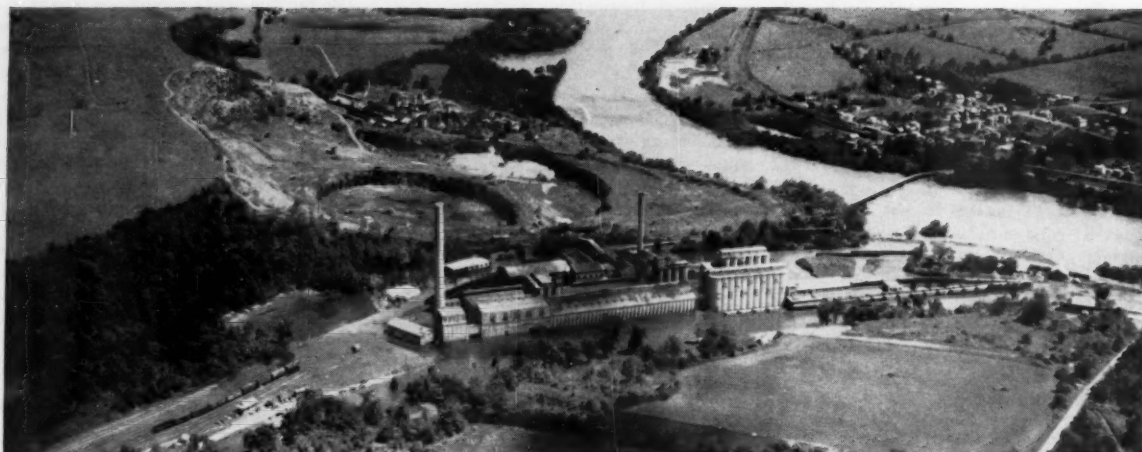
centralized lubrication, a market that several manufacturers are now tapping to the tune of nearly \$10 million a year. (CL systems, depending on the type and size of the machine with which they are associated, represent anywhere from 1 to 4 percent of the total cost of the machine.) Needless to say, much of the new equipment now being installed will use a lot of compressed air, once again proving its adaptability. Most CL systems are installed by the purchaser or are offered as optional equipment because manufacturers understandably are reluctant to add to the cost of machinery, especially in view of today's competition.

So far, the expansion of centralized lubrication has been limited to just a few of the more cost-conscious industries such as those engaged in automobile and steel production; but as labor, maintenance and replacement costs keep rising, many others are sure to turn to it as one more means of keeping a close checkrein on galloping costs. To summarize: centralized lubrication is a better, cheaper and more positive method of performing that vital chore than the old hand method. Compressed air is a good power medium for CL systems; in fact, is indispensable to some of the more popular and efficient types.



BETTER LUBRICATION — BETTER WORK

Correctly applied automatic lubrication can often solve production and operating problems. The milling machine pictured is used to cut slots in cast-iron distributor housings. With the original system of lubricating the gearing and bearings (they were packed with grease), the machine got so hot after running one hour that guide rods expanded and caused inaccuracies in the locations of the milled slots. When a Norgren Micro-Fog unit was installed the heat problem disappeared. The lubricator (at the lower-left on the machine) uses air at 30 psi pressure and feeds the oil fog through 30 inches of copper tubing and 36 inches of flexible hose. The sectionalized view of the unit (right) shows the method of operation. Particles of oil larger than 2 microns (.00007874 inch) drop out of the atomized oil stream before leaving the lubricator. The fog is formed as follows: air passing through a venturi draws oil from the reservoir through the drip tube in the sight feed dome; the drops of oil enter the venturi stream where they are atomized; and the stream is then allowed to circulate through the reservoir section where larger particles drop out.



PHOTO, JOSEPH M. LIGHTCAP

Diane Was No Lady

DURING the latter part of August, Hurricane Diane left lasting impressions in northeastern America of Nature's incredible power of destruction. Many of these manifestations ended tragically; others spared lives but wrought great property damage and human hardship. In all cases, man's inability to control such an irresistible force stood out. But amid the terror and havoc were occasional displays of capriciousness such, for example, as the show the breezy, temperamental Fury from the tropics put on at the Martins Creek, Pa., plant of Alpha Portland Cement Company on the night of August 19.

The plant is located in the Delaware River Valley 8 miles upstream from Easton, Pa. Martins Creek, normally no

more than a brook, flows southward through the Alpha property, passing between the processing plant and the nearby quarry from which the raw material for making cement is obtained. A few hundred feet to the south it enters the Delaware, which sweeps westward there in a wide curve before resuming its generally southerly course.

Heavy rains on Thursday, August 18, set the stage for the Delaware's rampage. Friday dawned bright and sunny, belying what was to come. At 4 o'clock in the morning power failed and 250 electric motors ranging up to 500 hp in size ceased to function. Kilns that had been producing cement clinker stopped rotating; ball mills grinding clinker and raw materials halted. As the day progressed,

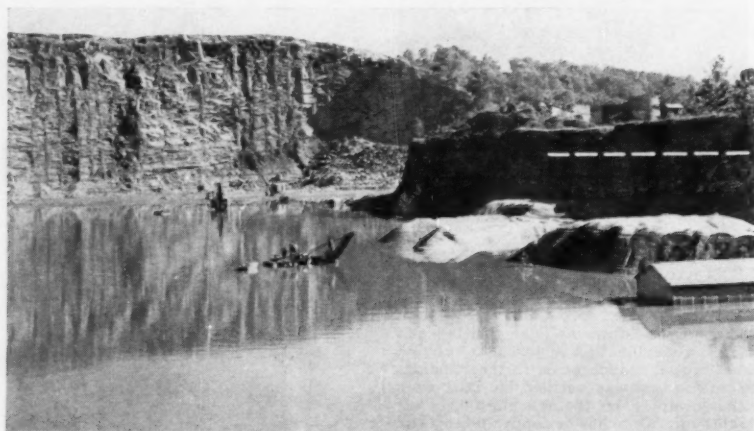
AS THE WATER ROSE

On the morning of August 19 the Alpha mill was surrounded with water that the swollen Delaware River had backed up in Martins Creek, which is just beyond the buildings. A few hours later the quarry (the stack at the left extends into the deeper part of it) was being flooded. At the lower left are automobiles on Highway 611 which disappears in the water in front of the plant.

the swollen Delaware backed water farther and farther up the creek. At 4 P.M. it topped the rise between the stream and the quarry and went over a wall that had been built in 1903 to hold back the highest previous flood on record. Soon a torrent was pouring in there and following the main access road into the pit, ignoring the hurried efforts of workers to block its progress. A little later another and wider stream overtopped the southern rim of the quarry. These are the lower boundaries of the pit, the site of which was originally a hill that sloped from north to south.

The quarry, a roughly oval-shaped depression approximately half a mile long, has been operated continually since 1905, an even 50 years. In that time 25 million tons of rock has been removed, representing millions of hours of work by drillers, blasters, shovel runners and trucks. Yet it took enraged Diane just eight hours to fill up the huge hole. By midnight it was a lake 105 feet deep in the center, where the floor has been carried some 50 feet below the general level, and 43 feet in the shallowest area. Engineers figured that the contents totaled 600 million gallons. The only part of the quarry still visible was the upper section of the north wall, which rises approximately 230 feet above the deepest excavation. All the quarrying equipment, including six electric shovels, five gasoline locomotives, four trucks, a crusher and a hoist, was inundated.

As the quarry is the sole source of raw material for the plant, and as cement production in the nation is lagging behind



PHOTO, GLENN BRAGG

AFTER 17 DAYS OF PUMPING

This was the scene in the quarry on September 13. Workmen on a raft are already flushing off the upper parts of a Marion power shovel that is reappearing to view. In the background are two more shovels. The dotted line on the wall at the right indicates the high-water mark.

demand, it was important that it be emptied as quickly as possible. There was only one way of accomplishing this: to pump the water out over the rim, reversing the course by which it had entered. After due consideration of all that this involved, the company decided that it was a job for a specialist and turned it over to Griffin Well Point Corporation of New York City. Despite the abnormal conditions that prevailed in the wake of the flood, that concern got its equipment in, managed somewhere to scrape up several thousand feet of large-diameter pipe—some of it had originally transported natural gas—and had water moving out on August 26, one week after Nature had turned on her gigantic faucet.

Griffin brought in seven 10-inch-discharge centrifugal pumps, each of 4000 gpm capacity. Five are driven by diesel engines and two by electric motors. From four to six were used at a time, the others serving as replacements at regular intervals. With 16,000 gpm of water coming out, it was computed that around 45 days would be required to undo what Diane had done in eight hours, and that estimate proved to be substantially correct. The floor of the upper level reappeared four weeks after pumping was started, and rock production was resumed on September 26, thirty-eight days after the enforced shutdown. Pumping out the deeper part of the excavation, still about 50 feet down and containing roughly one-third of all the water, was started immediately, the pumps being progressively lowered on a ramp as the water receded. As the lift

increased, the output of the pumps fell, but the bottom was reached on October 12 after 47 days of pumping.

Meanwhile, the tremendous task of getting the mill back in operating condition was in progress. At the crest of the flood the water was from 10 to 12 feet deep around the buildings. It came up so fast that the railroad company was unable to move some of the cars that had been loaded with cement for delivery. Cement that was being ground in the nine ball mills hardened and had to be chipped loose. Finished cement in the bottoms of thirty-four concrete storage silos likewise solidified.

After the unaffected material at higher levels had been removed attempts were made to break out the hardened deposit with chipping hammers, but there was so much of it that this method was soon abandoned because it was found to be painfully slow. Superintendent Charley Burnett solved the problem by drilling a dozen vertical holes into the mass through 12x20-inch "top-off" openings in the bottom that are normally used for discharging cement onto a conveyor running in a gallery underneath the silos. These were loaded lightly with dynamite, and after the charges were shot the material was further broken up with paving breakers.

As the water receded, pools remained at low points in the buildings and mud and debris were everywhere. Cleanup was accelerated by bringing in a dozen air-operated sump pumps. The water they picked up was discharged through hose lines to flush off machinery and even the floor, thus accomplishing a dual pur-



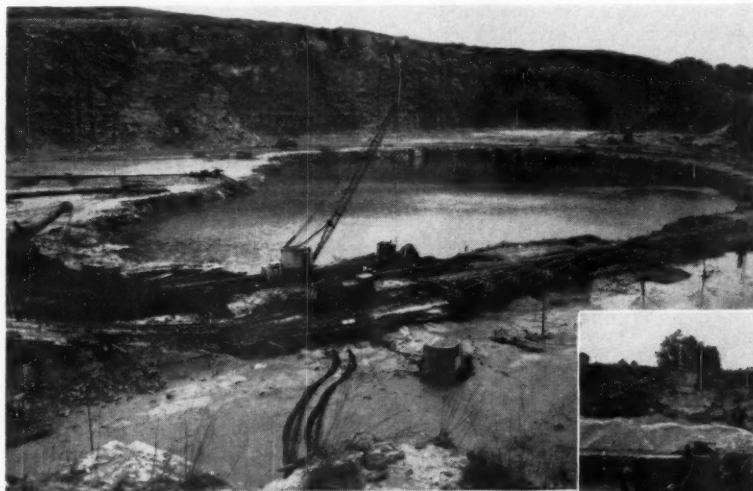
BALLS THAT WON'T ROLL

One of nine 7x26-foot finish grinding mills in which 45 tons of $\frac{7}{8}$ -inch steel balls were encased in hardened cement. The workman is breaking up the mass with an Ingersoll-Rand L-29 Pick-hammer.

pose. Drying out the 250-odd swamped electric motors was started as soon as possible. Some of them were trucked to electrical establishments for attention, but many were reconditioned on the property. Up to 49 kerosene and electric space heaters with blowers attached were applied to this job. Four of the units directed warm air into a big room to which the smaller motors were brought and where a maximum temperature of 180°F was built up. The other heaters were brought into play in tunnels and at other locations to dry large motors that could not be moved readily.

Less than three weeks after the flood came the plant was back on a partial schedule making clinker from rock that had been stockpiled. The clinker was stored pending later grinding. Operations were again normal by October 12.

The mill, with a capacity of 2,200,000 barrels of cement a year—about 6500 barrels a day—is the biggest owned by Alpha. It was headed towards the best production year in its half-century history when Diane stopped it abruptly with a vigorous slap of her decidedly moist hand.



50 FEET TO GO

A view (above) from the south rim of the quarry on October 1. The upper level had been dewatered but the floor of the lower level was still 50 feet down. Two pumps are shown beneath the tip of the crane's boom and two others across the water on the left bank. A close-up of the latter pair is at the right.



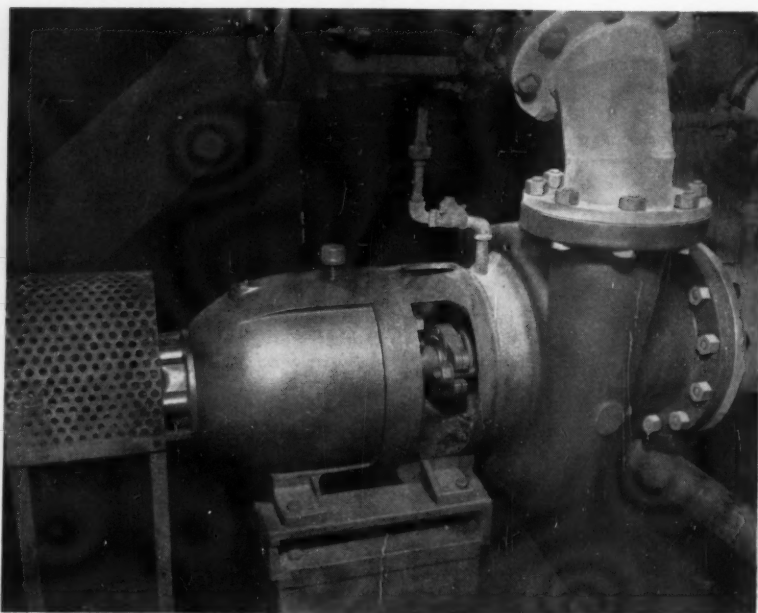
New Pumps Will Handle Many Industrial Liquids

INGERSOLL-RAND Company has introduced a new line of centrifugal pumps designed specifically for handling industrial liquids containing solids, air, or other gases and foamy solutions. The units are nonvapor-binding, self-venting, nonclogging and self-regulating. Foamy liquids with up to 50 percent entrained gases can be handled continuously without danger of losing prime or vapor-binding. In fact, air or gas can be injected directly into the suction. These characteristics make it possible to use the new centrifugals in many cases where heretofore only rotary or other types of positive displacement pumps were thought to be suitable.

It is said that the units can handle pulp and paper stock in concentrations as high as 10 percent, whereas consistencies of $3\frac{1}{2}$ to 5 percent were previously considered to be the maximum. Increased stock-chest capacities, reduced bleaching costs, substantial savings in the amount of mill water required, and elimination of down time due to air binding are realized. Stock chests can be completely emptied without diluting or wasting the stock.

Viscous liquids or mixtures with an unusually high content of solids can be pumped with ease and with freedom from clogging. Starch and gluten solutions, mash, distillery slop and spent grains can be handled as easily as water. In addition, the pumps may be used to transfer yeast cultures because they will not kill or otherwise harm the colony, as well as chemical crystals, whole potatoes, tomatoes and even fish without damaging the products. Where erosion and abrasion are a problem, the impeller and casing will outlast conventional centrifugal pumps by an impressively wide margin on account of lower velocities.

This exceptional performance is credited to the new patented impeller construction. In standard centrifugal pumps the width of the impeller passages decreases from the center to the periphery, but in this unit it increases. Because the



IN A PAPER MILL

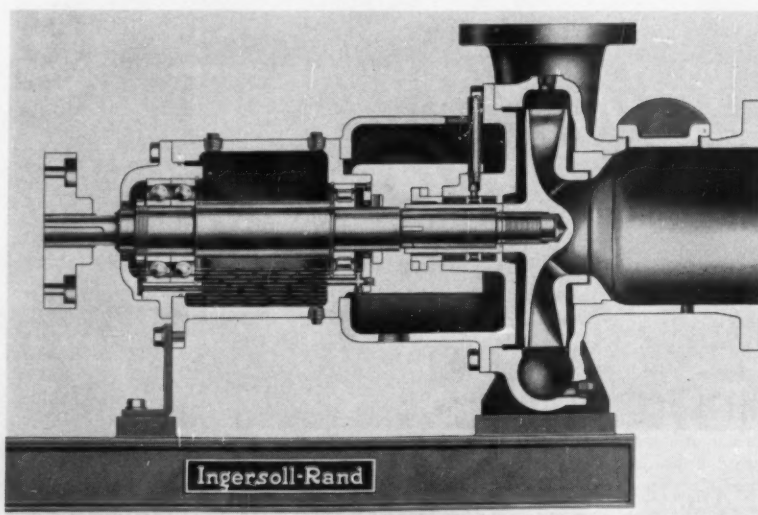
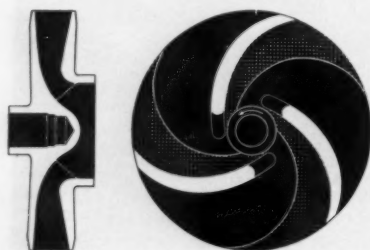
Paper stock having a consistency of 7 percent causes this 6-inch discharge pump no trouble. The pump previously in service couldn't handle it until it had been diluted to a consistency of 2.4 percent.

area at the outlet of the impeller is much greater than that at the inlet, the material handled cannot enter fast enough to replace the ejected liquid. This causes a vacuum space to form between the blades, thus permitting foamy liquids or those containing air or gas to be pumped without vapor-binding and loss of capacity or head. Unlike conventional designs, conversion to pressure from velocity is accomplished in the impeller rather than in the casing, thus resulting in lower

relative velocities. Vanes are fewer and volute areas are larger.

The pumps were field tested with excellent results in many different industries for more than a year in difficult and troublesome services. They are available in capacities ranging from 200 to 7000 gpm under heads from 5 to 225 feet. Additional information about them is contained in Form 7325 obtainable from Ingersoll-Rand Company.

Circle 1E on reply card

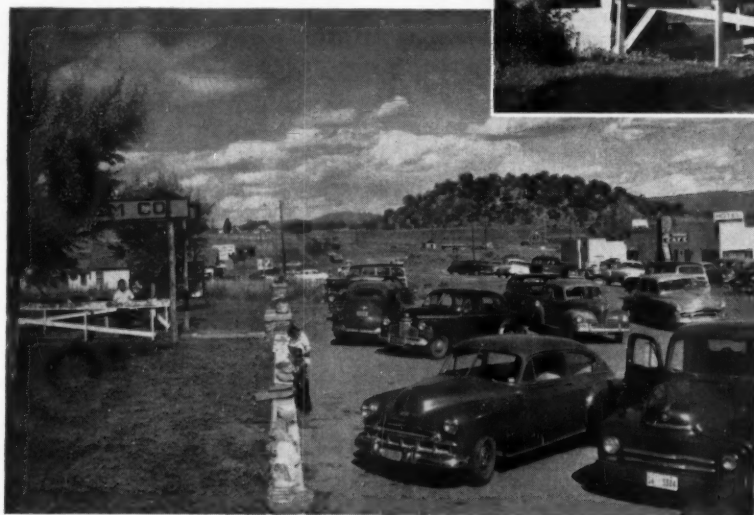
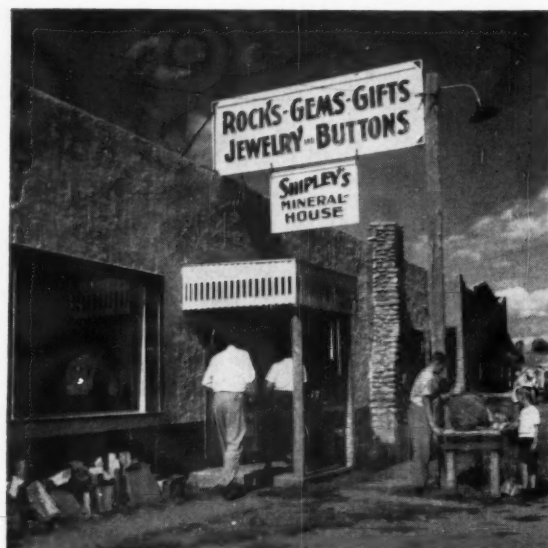


SECTIONAL VIEW

The pump owes its exceptional performance to the fact that the impellers (sketch at left) increase in width from the center to the periphery.

Gem Village, Hobby Town

CLEE WOODS



GEM Village is founded on hobbies. Frank Morse, a "rock hound," built a house by the side of the road and was a friend to anyone who loved rocks. More men and women came — some retired from active life — and constructed homes there all because they had a common bond in their interest in rocks. Today Gem Village, on Highway 160 and 18 miles east of Durango in southwest Colorado, is a town not only for "rock hounds" and "pebble pups" but also for those that pursue any other pastime.

Every summer the village holds a hobby show. Hobbyists come from far and near to see the work of others, to display their own and to meet their kind. Exhibits run from ambitious to modest showings in the back ends of pickup trucks. One of the most interesting seen there recently was a collection of antique

and modern buttons numbering in the thousands.

Gem stones, cut and uncut, figure prominently, as well as petrified wood, freak rocks and fluorescent minerals. There may also be a display of prehistoric Indian artifacts from New Mexico, Utah, Arizona and Colorado. There are sure to be old and new rugs, heirlooms and paintings, novelty furniture and tooled leather goods. Whatever has become a hobby for any individual is good enough for Gem Village.

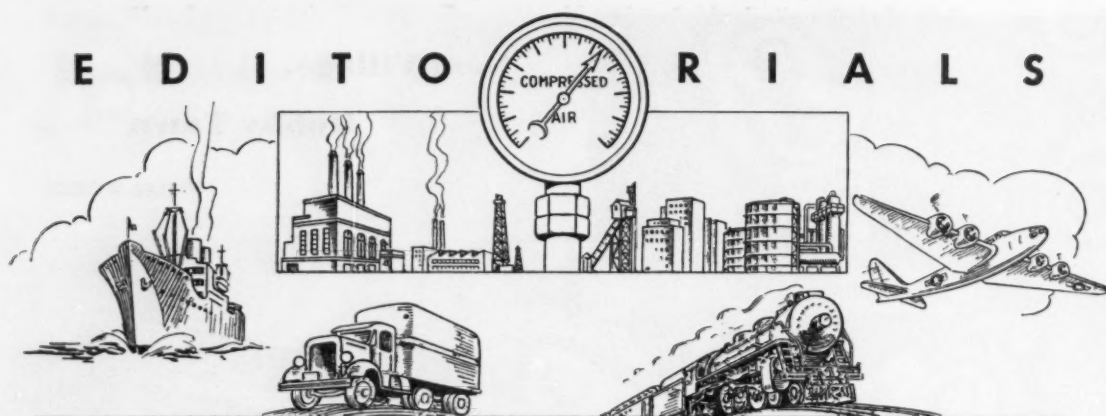
But rocks are the main dish — some in the natural state and unnumbered others cut and polished into magnificent specimens. Thousands are expensively mounted in rings, pins, bracelets and other pieces of jewelry — all so beautiful that it is hard to believe they came from what may have looked like any other rock until some expert eye fell upon it.

While a few commercial shops in Gem Village meet the extended wants of rock hounds by importing gem stones, some from as far away as China and India, the true hobbyist of this area combs the streams and mountains for any pieces that will "work up into something." From these finds the amateurs select and cut, many of them investing in diamond-studded saws, polishers and other lapidary equipment as they become more and more skillful.

People buy lots in the town in anticipation of the day of retirement. Some build their own houses, all modest, as one facet of hobbying. At first, observers doubted the future of Gem Village. Now the only question is how big it will become. At present three or four dozen hobby homes are located there, and more in adjacent neighborhoods. And all this has come about within the past eight or ten years.

All ages get the bug. Many rock hounds are persons no longer actively engaged in business and find the hobby absorbing over and beyond any thought of profit. Naturally, boys outnumber girls as pebble pups. Whoever they are and of whatever age, they yield more and more to the lure. Rocks in themselves are intensely interesting. In them we read the first pages of geological history. They were man's oldest raw material for farm tools, weapons and houses. Yes, and for jewelry. Gem Village feels this elemental appeal of rocks. But above everything else, most of its residents just like to "make things" out of rocks.

E D I T O R I A L S



GEORGIUS AGRICOLA, often called the "father of mineralogy," died 400 years ago this month. The mining industry probably won't pause to pay homage to this Saxon scholar, but it undoubtedly owes him a debt of gratitude for putting down on paper the first orderly and comprehensive account of the medieval practices of mining and metallurgy. His *De Re Metallica*, which was translated into English in 1912 by Mr. and Mrs. Herbert Hoover, was the first book on mining of practical significance, and the only substantial work on the subject until at least 200 years later. In addition, he contributed a whole series of books on minerals and related topics and is credited with having laid the foundation of the science of physical geology.

The thoroughness with which he recorded the methods of taking ores from the ground and extracting their metallic contents is all the more remarkable because of the fact that Agricola never engaged in mining. He was merely an observer who absorbed knowledge from others and put it into understandable terms for posterity. He was perhaps one of the first great scientific reporters. Yet he went much farther than merely repeating the opinions of others. He enunciated the theory of ore deposition and contributed much other original thinking. Like a good reporter, he stuck to the facts, which distinguishes his writings from previous ones in the mining field that were based on speculation. Of his *De Re Metallica*, he wrote: "I have omitted all those things which I have not myself seen, or have not read or heard of from persons on whom I can rely."

Agricola became identified with the mineral industries purely by chance. Born Georg Bauer (his name was Latinized by this teachers as was then customary), he received a B.A. degree from the University of Leipsic and spent two years as a teacher of Latin and Greek in the municipal school at Zwickau. Two years later he was made principal. One of his assistants was Johannes Forster, who afterwards collaborated with Mar-

HERITAGE OF AGRICOLA

tin Luther in translating the Bible. Agricola began his writing career at that time with the preparation of a small Latin grammar.

At the age of 28 he became a lecturer at the University of Leipsic, and two years later he went to Italy where he studied philosophy, medicine and the natural sciences at three universities. He returned to Zwickau in 1526, and in the following year was chosen town physician at Joachimsthal, which has been in the news in recent years as a source of uranium ore. That Bohemian mountain settlement was located in central Europe's leading metal-mining district. Local discoveries had been made only eleven years previously, but Joachimsthal was already a boom camp with several thousand inhabitants.

That was Agricola's introduction to mining. Apparently fascinated by it, he began spending all his spare time in and around the mines and smelters. Besides talking endlessly with the best-informed mining folk, he diligently sought out and read all the Greek and Latin mining literature he could find. It was then that he apparently realized that the subject had never been covered adequately and decided to do something about it.

One of the local mining men that he cultivated was Lorenz Berman, who became "the learned miner" in Agricola's *Bermannus*, a catechism on mineralogy, mining terms and lore. It was published in 1530. The closest Agricola got to actual mining experience was to become a shareholder in the God's Gift Mine at Albertham. In 1545 he wrote that he had "through the goodness of God . . . enjoyed the proceeds of this God's Gift since the very time when the mine began first to bestow such riches." One may judge that it was a profitable investment.

Leaving his position at Joachimsthal in 1530, he spent two or three years making the rounds of the mines and studying the methods. About 1533 he became city physician at Chemnitz, in

Saxony, where he resided for the remainder of his life. Little is known of his activities during the ensuing decade, but he is known to have been consulted on matters of mining engineering. Among those seeking his advice was Duke Henry of Brunswick who had some mines in the upper Harz Mountains. It is to be assumed that he was busy writing, because his books began to appear in rapid succession around 1540.

Agricola probably started working on *De Re Metallica* by 1530 or before. All told, some twenty years of effort went into it. The manuscript was apparently finished in 1550, but six more years elapsed before it was printed, and the author never lived to see a copy. The delay was perhaps occasioned by the monumental task of preparing woodcut engravings to illustrate the methods and equipment. There were 289 of them. The artist or artists were not identified, but Agricola stated that he had employed the best talent available "lest descriptions which are conveyed by words should either not be understood by men of our times, or should cause difficulty to posterity."

Aside from his chief interests of medicine and mining, he had many others, to which his varied writings attest. He also found time to serve four terms as burgo-master of Chemnitz, and he seems to have been highly respected even though he was an ardent and unwavering Catholic at a time when a wave of Protestantism was sweeping the country. He received much help and encouragement from Princes Maurice and Augustus, both protestants. Through his efforts, Maurice was induced to establish the nuclei of several notable museums in Dresden.

Although not directly engaged in mining, Agricola had the philosophy of the mining country. For example, he reported to his princes: "Greater wealth now lies hidden beneath the ground in the mountainous parts of your territory than is visible and apparent above ground." In these remarks one detects the perennial optimism of the men who delve in the ground for riches.

— This and That —

India to Tunnel Mountain

Twin vehicular tunnels 1½ miles long will be driven through Bannihal Mountain between India and Kashmir, just below the snow line at an elevation of 7300 feet. The tubes, one for traffic in each direction, will be 17 feet wide and 18 feet high, with cross connections at intervals. The tunnels will provide an all-weather road to the Kashmir Valley. They will be fully lighted, artificially ventilated and provided with fire-fighting and other safety devices, as well as parking strips for vehicles that may become disabled.

★ ★ ★

Documentary Ink Is 100 Years Old

Writing ink that is enduring enough to qualify for use on documents is of comparatively recent origin. Inks of a fashion were known in ancient China and India, and other nations probably had some sort of fluid to write with, but they were all of poor quality. Up to a century ago ink was not a standard article of commerce, and we are told that the family supply was made in the home, as were soap and other household necessities.

The basis of most modern black inks is essentially a solution of iron gallate—an ester or salt of tannic acid derived from the tannin that is found in tea, some oak leaves and organic deposits that form on certain vegetable growths. August Leonhardi of Dresden, Germany, obtained a patent for producing ferro-gallic ink in 1856, but Victor Rosendahl of Sweden may have discovered a suitable formula a year ahead of that. In any event, the facts show that Rosendahl began making an acceptable ink in his native city of Filipstad in 1855, and the concern he founded is still in business there. A centenary celebration was held this fall.

★ ★ ★

Swedish Lightweight Concrete

Even though wood is abundant in Sweden, more than half of the country's buildings are now constructed of lightweight concrete materials of various kinds. The first of these was developed 35 years ago by an architect, Axel Eriksson. The AB Skövde Gasbetong company began manufacturing lightweight cellular concrete in 1923 and produced the blocks with which Stockholm's first tall building was erected in 1923-25. It is still one of the leaders in the field and its products bear the trade name Durox.

The concern was formed after Nobel prize winner Gustaf Dalén, a native of

the Skövde district, discovered that local deposits of alum shale and limestone could be successfully combined for the purpose. Later certain other substances were also found to be suitable for use. Some of the many licensees of the process utilize fly ash from power plants that burn pulverized coal. A few of them in France have run pipe lines into their establishments through which the material is delivered by pneumatic pumping as fast as it becomes available.

Durox weighs 31 to 44 pounds per cubic foot, as compared with 75 to 100 pounds for ordinary bricks, and can therefore be made into fairly large units without becoming too heavy to handle. This reduces the number of joints required, as well as the time and labor needed for assembly, and improves the insulation value. Durox can be drilled, sawed and nailed like wood.

The manufacturing process is somewhat similar to the baking of bread. The essential calcareous and silicious ingredients are ground into a flourlike powder, mixed, sprinkled with water and "leavened" with aluminum powder. The mass is then worked like dough and poured into greased baking molds. These are transferred to a fermenting chamber where the mixture rises to twice its original height. After the cakes have been baked with steam they are cut with wire saws into blocks or slabs of desired sizes. The final step is hardening in cylinders containing high-pressure steam. This treatment is claimed to prevent the pieces from shrinking later on.

★ ★ ★

Air Curb Corrosion

During the refining of certain kinds of crude oil considerable hydrogen combines with sulphur to form highly corrosive hydrogen sulphide. The compound reacts with steel piping and vessels at atmospheric temperatures to produce atomic hydrogen at points where water collects. The atomic hydrogen accumulates, and some of it penetrates minute defects in the surface of the metal and forms molecular hydrogen. In alkaline systems, if air is not present, the process continues until blisters and fissures appear. The equipment eventually fails.

All this can be overcome by admitting the correct volume of air, according to two members of the staff at Shell Oil Company's Wood River (Ill.) refinery. In a paper presented to the National Association of Corrosion Engineers, they report that some of the hydrogen sulphide reacts with air to form a coating of polysulphide—a complex chemical—on the steel. Atomic hydrogen cannot penetrate it.

The treatment has proved successful during a 2-year trial period at Wood River, and the air does not affect the quality of the refinery products. It is claimed to be important to add just the right amount of air. The industry has been using various other means, including expendable steel linings for vessels and different coatings. Some are effective in the case of large equipment but not suitable in piping and condensers.

★ ★ ★

Move to Predict Floods

Like the United States, India has recently experienced disastrous floods. In a 6000-square-mile coastal area in Orissa 300,000 persons were trapped when an embankment of the Mahanadi River broke, and airplanes, helicopters and boats were pressed into service to rescue some and to deliver or drop food to others.

In a move to predict floods and thus be able to prepare for them, the Indian Government began sometime ago to establish hydro-meteorological observatories on the upper reaches of some of the country's main river systems. In six states in the Himalayan mountain watersheds of some of the tributaries of the Ganges it is proposed to locate 118 such stations during the next two years. Five of them are already operating. The data collected will give advance information regarding the magnitude of floods.

India and Pakistan are also planning joint flood-control measures where their territories adjoin. This is necessary because some streams such as the Indus River rise in India and flow into Pakistan. India has promised to supply Pakistan with meteorological data that will be helpful in forecasting floods.

★ ★ ★

Longest Highway Bridge

The longest vehicular bridge ever built, and second only to the 30-mile railroad span over Great Salt Lake in Utah, is under construction across Lake Pontchartrain immediately north of New Orleans, La. It will be part of a toll highway, called the Greater New Orleans Expressway, which is intended to provide faster service between the city and the fast-growing residential district on the northern side of the lake. The bridge itself will be 24 miles long and 33 feet wide, with a 28-foot 2-lane roadway. It will be supported on prestressed 54-inch concrete piles driven into the lake bed through water that averages 15 feet deep. The cost, including approaches, will be \$30 million. The structure is scheduled for completion by January 1, 1957.

Nonlubricated Compressors Solve Food-Processing Problem

SEVERAL years ago one of the nation's largest meat packers experienced some difficulty in processing foods where quality depended upon automatic temperature-control instruments. In one case where accuracy of instrumentation was of importance, an appreciable quantity of a rather expensive product had to be reprocessed to pass inspection and avert total loss. Serious study was given to the reason for the lack of dependability and apparent failure of the instrumentation equipment. The results of this investigation were reflected in rather radical changes in company policy as regards the purchasing, application and installation of automatic controls.

One of the main reasons for the poor performance was found to be the compressed air used for controlling the instrument mechanisms. This was true of all the pneumatic systems, regardless of type, but was more prevalent in some than in others. The air did not do its job properly because it contained lubricating oil carried over from the compressor cylinder, as well as water condensed from vapor as the heat of compression was dissipated.

All manufacturers provide filters and moisture separators for the lines that supply their instruments with compressed air. In the case of the systems involved, all were served by these devices and more than ordinary care was taken to see that the lines were clear before each operating cycle. But despite these precautions, water and oil were continually showing up in the instrument mechanisms and on the air-escape nozzles which regulate the flow of air from the systems.

In some instances the air came from a central compressor station; in others from a conventional unit located near the processing operation. In all cases the machines had lubricated cylinders, and in only a few was the air passed through dependable auxiliary aftercoolers after being compressed. Special separators with unusual filtering media were purchased or built in an effort to remove the entrained oil and water, but, with the exception of a type provided with activated carbon, none produced the desired result. Perhaps the performance of most of the filters can be best described as follows: they successfully cleaned but did not remove the oil vapors, which reached the instruments regardless of the installation. While the activated-carbon separators freed the air of oil and water, they needed regular attention, and the same instrument trouble developed if they did not receive it.

After it was determined that filters did not seem to solve the problem satisfactorily it was decided to install compressors with carbon piston rings, which require no cylinder lubrication, in all

processing rooms involving instrumentation. This took care of the oil, and properly designed aftercoolers were furnished to reduce the moisture content to a point where it would cause no difficulty. This equipment, plus the use of copper tubing for all air lines $\frac{3}{4}$ inch and smaller in diameter, has given remarkably trouble-free performance.

Before the carbon-ring type of compressor was adopted, considerable concern was expressed as to its depend-

ability and service life. Investigation of previous installations provided encouraging information, but the program was carried out with the expectation that the rings would have to be replaced after a year. This has not had to be done, however; in fact, several years of experience have shown that the life of carbon piston rings so nearly approaches that of the conventional lubricated type that there need be no fear of increased compressor maintenance costs.

Refrigerated Space Guarded by Air Doors

MORE than one-third of all refrigerated warehouse space added to the nation's total during the past four years is in Florida. Responsible for this is the growing quantity of frozen fruit-juice concentrate being processed there, plus the fact that the state's rapidly rising population increases the need for food storage facilities.

The rapid growth of supermarkets in the Miami area makes that city a center of the storage industry. Recently erected there is a \$1,000,000 establishment operated by Zero Food Storage, Inc. The 1-story building measures 330x233 feet and contains 621,308 cubic feet of freezer space and 87,909 cubic feet of cooler space. It is the first such structure to have an aluminum roof, which combines light weight, freedom from corrosion and

good insulating properties. The roof is covered with marble chips to reflect sunlight.

An inclosed corridor that surrounds the refrigerated section prevents the sun's rays from reaching the walls. It is used as a truck-loading dock in the front and a railroad dock with room for five cars in the rear. Eleven rolling doors in front and five in back remain closed except when goods are passing through them. Air-operated doors made by Jamison Company, Hagerstown, Md., and controlled by push buttons that hang from overhead both inside and out, provide access from the corridor to the refrigerated area. So that the space will not be entirely open at any time, swinging doors inside automatically close when the larger outer doors are opened.



WAREHOUSE AND AIR DOOR

Shown here is a lift truck with a pallet of merchandise passing into the refrigerated area through one of the pneumatically operated doorways. The button that controls the door from this side is in the white knob hanging down at the right. Air piping is shown along the wall at the top. The truck has pushed open the swinging doors that fill the gap when the air doors are open.

Powerama Shows Varied Uses of Diesel Power

ASPECTACULAR and informative exhibition of construction and road-building machinery for the general public was a feature of General Motors' 26-day Powerama in Chicago during September. The Powerama was arranged to observe the production of 100 million diesel horsepower by GM. The corporation's participating divisions were Detroit Diesel, Cleveland Diesel and Electro-Motive. Twenty-three acres of displays showed how some of this vast horsepower is applied in American industrial, marine and railroad fields.

The roadbuilding exhibit, planned by GM's Detroit Diesel Engine Division, centered about a section of "highway" in various stages of construction. Practically every type of machine used in building the nation's roads was displayed at stations covering the entire range from rough terrain to finished concrete and asphalt surfaces. Included were drills and shovels and earthmoving, grading, loading, ditching, compacting, mixing and paving equipment. As it was impossible in all cases to show actual "live" machines, easily identifiable scale models of some types were mounted on a



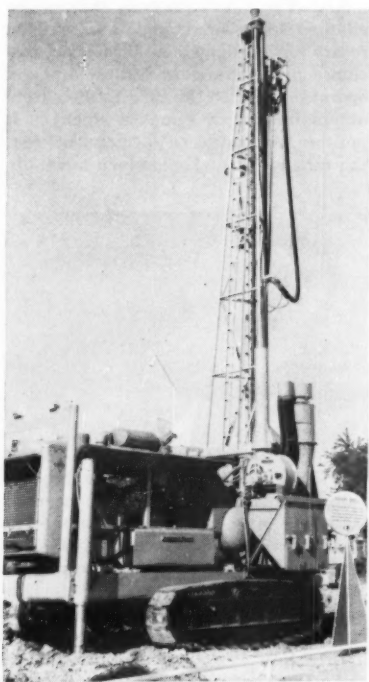
GENERAL VIEW OF ROADBUILDING-EQUIPMENT SECTION

rotating carrousel 30 feet in diameter. In the center was a gold-plated engine representing GM's one-hundred-millionth horsepower unit.

Diesel power on the farm was represented by a tractor, a portable feed mill and an irrigation system, all functioning. Plowing demonstrations were held hourly on a "plot of ground" which, of necessity, was a paved area on which soil by the carload had been dumped. After

every demonstration the earth was compacted and its normal moisture content restored so that natural plowing conditions would result. The soil was plowed as many times in the 26 days as it ordinarily would be in 338 years.

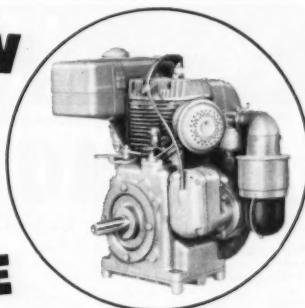
At a specially built pier was displayed a 65-foot GM diesel-powered shrimp boat from the Gulf of Mexico, and alongside of it was one of the smallest diesel-powered yachts built.



DRILLMASTER ON DISPLAY

The compressor that operates this machine for drilling large blast holes is driven by a GM 219-hp diesel engine.

This is the NEW WISCONSIN Model ACN, 5½ H. P. Single Cylinder HEAVY-DUTY *Air-Cooled* ENGINE



Here is a new, light weight engine, designed and built to Wisconsin heavy-duty standards in all details, offering original equipment builders and engine users maximum power advantage and performance in a 2.3 to 5.6 hp. range at 1600 to 3600 rpm.

Like all Wisconsin Engines, the Model ACN has the built-in Lugging Power that hangs on through the shock load pinches and keeps the job moving without stalling. With a 2½" bore x 2¾" stroke, it has a 14.88 cu. in. displacement.

Heavy-duty features include tapered roller main bearings at BOTH ends of the crankshaft; rotary type high tension OUTSIDE Magneto with Impulse Coupling for quick, all-weather starts at low cranking speed, pump-circulated splash lubrication plus efficient AIR-COOLING from extreme sub-zero to 140° F.

Perhaps this is just the power component you have been looking for — power to fit the machine; power to fit the job. Write for Bulletin 5-179.



WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air-Cooled Engines
MILWAUKEE 46, WISCONSIN

Better Insulation — Longer Motor Life

IT HAS long been known that the life of a motor depends largely on the life of its insulation. It is therefore of interest to learn that General Electric Company, after more than two years of research, has developed a system of insulation using Class H materials that is said to withstand temperatures of 407°F, as

compared with 266° for the Class B materials formerly utilized. It is reported that the new system not only meets the thermal requirements of Class H but also has good mechanical properties and high resistance to dirt, vibration and moisture. It is applied to the company's improved line of d-c armored motors

built for heavy-duty service in steel mills, power shovels, mine hoists and elsewhere where adjustable-speed d-c drives are required.

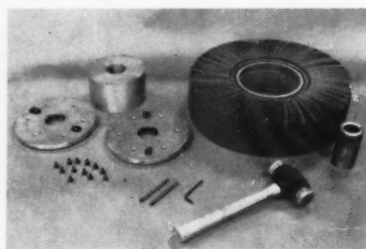
The basic material is G-E mica mat, which consists of small flakes of mica that are partially dehydrated and ground in an aqueous medium to form a slurry which is converted into a homogeneous material much like wood pulp is turned into paper. The mat is impregnated with a silicone resin that serves as a binder and gives the inorganic substances the necessary mechanical strength. Further strength is obtained by backing it with glass. In wrap or tape form, the mat is used to insulate com-

mutating, field and armature coils, the two latter also being coated with a silicone varnish that was developed by the company. In addition to high thermal resistance, the preparation has excellent mechanical properties and can be cured at low temperatures.

To determine the service life of the insulating system, two armored motors—one with the new Class H and the other with the former Class B insulation—were coupled together and run alternately as a motor and as a generator. They were driven at four times their rated speed, subjected to severe vibration and the shunt field circuit was abruptly interrupted at regular intervals to produce an inductive kick that threw electrical stress in the field-coil insulation. The average insulation temperature during each cycle exceeded 392°F.

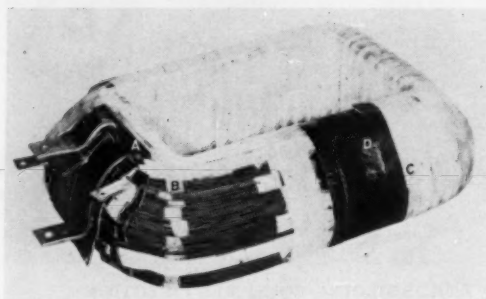
In reporting on the test, which is still in progress, company engineers stated that the Class B motor burned or roasted out after three months of operation while the Class H has given no evidence of insulation failure after a period of seven months.

A combination polishing and grinding wheel made up of hundreds of pieces of abrasive-coated cloth is something of an innovation in metal-finishing products. Introduced by Minnesota Mining & Manufacturing Company, the wheel is mounted on a hub assembly that can be adapted to fit any spindle and used on rotary or straight-line automatic machines or on standard lathes for hand operation. Called the PG, it differs from others in that it removes stock as it polishes. According to the manufacturer, the rate of cut and microinch finish ob-



tained remain constant from the start when the wheel is new until it is worn down to the hub because fresh mineral grains are exposed as it becomes smaller. At present, aluminum-oxide and silicon-carbide wheels are available in the full range of grits and in twenty stock sizes from 14 to 17 inches in diameter and from 2 to 6 inches wide. The accompanying picture shows the components of the assembly—the wheel, hub, two flanges, screws and bushings.

Circle 2E on reply card



COMPOUND FIELD COIL

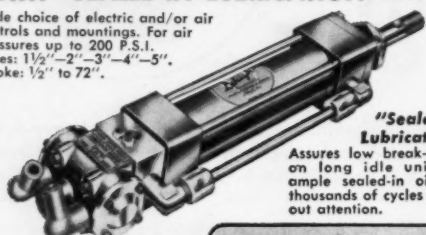
The component is partly stripped to show Class H insulation in its various stages: "A," layers of mica that serve to insulate leads and terminals from coil body; "B," ties of fiberglass tape pre-treated with silicone varnish that hold parts of the coil in place during and after winding; "C," outer wrapping of glass tape that is applied after impregnation; "D," mica tape that is used to increase dielectric strength and resistance to heat. The new coils are interchangeable with Class B coils in older motors of the line.

Lehigh INC. A COMPLETE LINE OF AIR CONTROL EQUIPMENT

Including precision-made HEAVY-DUTY

AIR MOTORS WITH "SEALED-IN LUBRICATION" Pat. Pend.

Wide choice of electric and/or air controls and mountings. For air pressures up to 200 P.S.I. Bores: 1½"-2"-3"-4"-5". Stroke: ½" to 72".



"Sealed-in Lubrication" Assures low break-away on long idle units — ample sealed-in oil for thousands of cycles without attention.

You Are Invited To Consult Our Engineering Department freely on all air automation or replacement problems. Trained factory personnel available nationally.

Write for Catalogs and Name of Nearest Lehigh Representative

Lehigh INC.

ENGINEERS & MANUFACTURERS
1513 Lehigh Drive
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AIR CYLINDERS
1½" to 8" bore



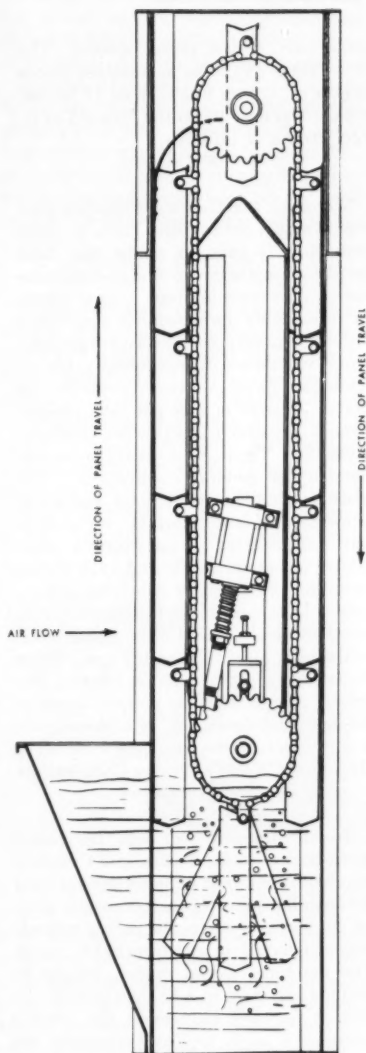
3 or 4-Way
AIR POWERED VALVES

Air or electrically operated.



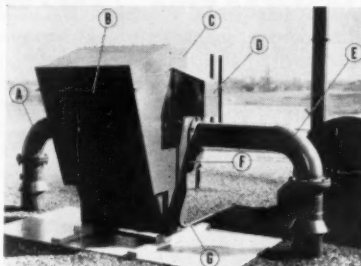
Lehigh Minor AIR VALVES and CYLINDERS
Low priced, light duty. For air operated jigs, fixtures, high speed operations.

Air Piston Operates Moving Filter Curtain



A FILTER that is designed for cleaning large volumes of air used in cooling stores, offices and factories is offered by the Air-Maze Corporation, Cleveland, Ohio, which also makes filters for cleaning air taken in by air-compression systems. Known as the Automaze, the new unit consists of a wire-mesh curtain that continually revolves over an upper and a lower pair of sprockets. It moves upward in front and downward in the rear, the air passing through it twice.

At the bottom of its travel, the curtain is immersed in a bath of liquid adhesive, some of which clings to it and serves to catch fine dust, pollen and other foreign materials in the air. The curtain moves intermittently in pulses imparted to it by the time-controlled action of an air cylinder that turns the lower pair of sprockets. With each pulse, the section then in the adhesive bath



HOW IT WORKS

The sectional view (left) shows the air-piston arrangement for turning the lower sprockets with a pulsating movement that vigorously shakes the part of the curtain then in the adhesive bath. This serves to deposit dirt collected during the previous revolution and also to recoat the screen with liquid designed to catch dust and other fine material carried by the air stream being filtered. A typical installation of a single filter unit is shown above. A and E—intake pipes; B—weather louvers; C—curtain; D—control box; F—plenum chamber; G—compressed air and electric lines.

is swung back and forth repeatedly, thus washing out the deposit clinging to it, which then settles to the bottom for subsequent removal.

The curtain is of cellular construction, the cells being made up of crimped gal-

vanized steel-wire mesh having increased density in the direction of the air flow. While it is in the vertical position, the cells in each cross row are interlocked with the neighboring ones above and below by means of V-shaped members in their upper and lower edges.

Where two or more filter units are operated side by side, each has its own air-piston drive mechanism and no problem of alignment is therefore involved. Air is distributed to all of them through copper tubing, and the flow is controlled from one point. There are no electrical connections in the air stream passing through the curtains to act as a fire hazard.

Circle 3E on reply card

As a substitute for friction tape there is now available a pressure-sensitive black tape that sticks well to its own backing and application surfaces even after it has aged on stock shelves or in a tool chest. It is also said to build up less bulk in multiple wraps because it is thinner than the earlier product, to have twice the insulating resistance and to be easier to unwind. Known as Permacel 64, it is $\frac{3}{4}$ inch wide and comes in 60- and 90-foot lengths. It is made by Permacel Tape Corporation.

Circle 4E on reply card



Simplify Your Bulk Storage with a

SAUERMAN

MACHINE



Sauerman installations provide economical handling of a wide variety of bulk materials, from bauxite to zinc ore . . . at rates ranging from 10 to 800 cu. yds. per hr. Storage areas range from a small bin to ten acres or more.

Quick change from stockpiling to reclaiming is accomplished by unclamping and re-attaching the operating cables so as to turn the bucket around when the power is applied. Non-caving or free-flowing materials are handled with equal efficiency.

The operator can be located in a safe cab overlooking the work area. Many Sauerman installations are remotely operated through air or hydraulic controls.

Let Sauerman engineers show you how to use your storage area to its fullest extent. Send for Catalog E, Bulk Storage by Power Scraper and 32 Tested Methods For Handling Bulk Materials. Request the following Field Reports:

FR-224
FR-227

Handling Ore with Drag Scrapers
Storage and Handling—Potash

SAUERMAN BROS. INC.

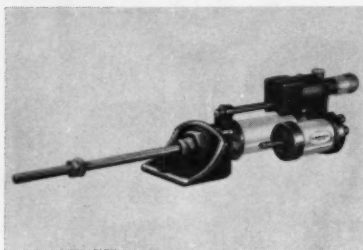
648 S. 28th AVE.

BELLWOOD, ILL.

Circle 18A on reply card

Industrial Notes

To its line of Hydro-Checks, The Bellows Company has added a self-contained hydraulic resistance unit that was developed primarily for use with its air motors where extreme precision of movement is required. Designated as DCP-50A, the unit is said to maintain a preset feed rate with nearly 100 percent accuracy regardless of changes in temperature, load and air-line pressure. Turning a calibrated knob adjusts the feed rate, and optional devices include auxiliary valves for stopping the piston rod at any desired point in the power stroke and for



interrupting the Hydro-Check's control to permit movement through any frac-

tional part of the power stroke. The DCP-50A is available in standard stroke lengths of 2, 4, 6, 9, 12, 15 or 18 inches, and control may be on the forward or retract stroke or on both.

Circle 5E on reply card

Assure constant material flow from your bins and hoppers with . . .

DEPENDABLE

SAFE

ECONOMICAL

QUIET

PneuBin

Pulsating Panels

PneuBin is a new concept in material flow engineering. The PneuBin unit consists of steel-backed, neoprene, pulsating panels, strategically located on the inside walls of your present bins. Working off the plant's regular air supply, PneuBin is inflated and deflated in controlled cycles, causing the contents of the bin to be "positively displaced" and thus assures free flow of material through the discharge opening.

DEPENDABLE—PneuBin is on the job whatever the material flow problem. PneuBin's principle of "positive displacement" moves the bin contents, not the bin . . . assures constant, free-running material discharge. Depend on PneuBin to insure material flow.

SAFE—No manpower is needed to facilitate material flow from bins when PneuBin is on the job. No more prodding, poling or sledge-hammering. Depend on PneuBin to insure material flow . . . safely.

ECONOMICAL—PneuBin cuts maintenance costs, saves money year after year. Reduce bin damage . . . increase bin life. Depend on PneuBin to insure material flow . . . safely, economically.

QUIET—PneuBin pulsating panels breathe . . . not snore. No hammering or loud vibration noises. PneuBin's quiet operation adds to overall plant efficiency . . . reduces employee fatigue. Depend on PneuBin to insure material flow . . . safely, economically, quietly.

Send for "Flow Stoppage" and free literature. PneuBin engineers will gladly make recommendations with no obligation on your part.

PneuBin

A PRODUCT OF
GEROTOR MAY CORPORATION

1531 Maryland Ave., Baltimore 3, Maryland

Circle 19A on reply card

Nicrobraz stainless-steel brazing alloy is now made, for the first time, in paste form that is easy to apply and fuses readily. It is a mixture of nickel-chrome-boron alloy powder and a new cream flux that holds the powder in suspension without separating for extended periods. Three variations in flux-metal ratio are available: Type A, which contains the largest amount of flux per unit weight; Type C, in which the powder predominates; and Type B, a mixture recommended for general application. The paste is said to have good spreading properties in any dilution, as well as flow and brazing characteristics when heated to between 1850 and 1950°F, the standard temperature range for Nicrobraz. It is suitable for uses involving stainless steel; nickel-base, cobalt-base and similar alloys; low-alloy and carbon steels and copper; and for brazing dissimilar metals such as copper tubes or sheets to stainless steel. Nicrobraz paste is a product of the Stainless Processing Division of Wall Colmonoy Corporation.

Circle 6E on reply card

To its line of wet-hole horizontal earth-boring tools, Hydrauger Corporation has announced a model designed for the installation of ¾-inch domestic service connections where the piping extends beneath paved or nontrenchable areas. The machine, a sled model, weighs 80 pounds and is set in a 12-inch trench. To give it forward movement the worker operates a cable reel by repeatedly depressing a pedal, and power for running-in the piping is obtained by an air motor that develops more than 3 hp with air at 85 psi. The new Hydrauger—the 2ST—



has been tested for more than a year under actual service conditions and has placed a fully assembled 45-foot string of wrapped pipe in one uninterrupted operation. However, direct runs of such piping are limited to soils that form a slippery mud when mixed with the water (2 gpm) that runs through the boring bit. In rocky formation, a standard boring-bar section and 2-inch pilot bit are used to drill a hole through which the piping is inserted.

Circle 7E on reply card

What is claimed to be the world's first successful industrial ultrasonic flowmeter has been introduced by Fischer & Porter Company. It is the culmination of four years of work by The W.L. Maxon Corporation and is being made and sold by Fischer & Porter under a license. Known as the Ultrasonic Flowmeter, it measures either mass or volume flow of virtually any fluid (possibly also molten metal) regardless of its electrical con-



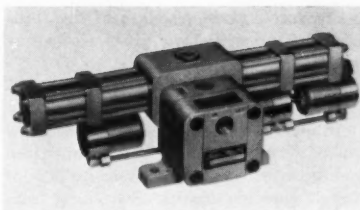
ductivity and without being affected by accompanying variables. Built into a short pipe section, it has no restrictions or moving parts to obstruct the flow or cause clogging, and pressure drop is said to be virtually zero. The rate of volume flow is measured by two transducers to which a third one may be added to give density measurement. Present models are available in varying materials depending upon corrosion-resistance requirements and have a maximum capacity of 12,000 pounds per minute with a fluid density range of approximately 2.5 to 1. The temperature limit is minus 50 to plus 225°F, standard, and up to 750° with special provisions; pressure limit is 150 and 300 psi. The instrument can be adapted to any standard pipe size down to 2 inches. In the accompanying picture it is shown connected to a dial indicator.

Circle 8E on reply card

A new raw material is being derived from the carbonization of lignite being used as fuel in the generation of power for smelting aluminum at the Rockdale, Tex., plant of the Aluminum Company of America. A low-temperature tar, it is known to contain valuable chemical compounds. A prototype carbonizer and tar-recovery unit has been built and will

supply 16,000 gallons a day when operating at capacity. Alcoa and Texas Power & Light Company are cosponsoring a research and utilization program being conducted by the Battelle Memorial Institute of Columbus, Ohio. The findings, together with lignite-tar products, are to be made available to participating chemical companies. Any surplus not purchased by the group can be obtained by other firms.

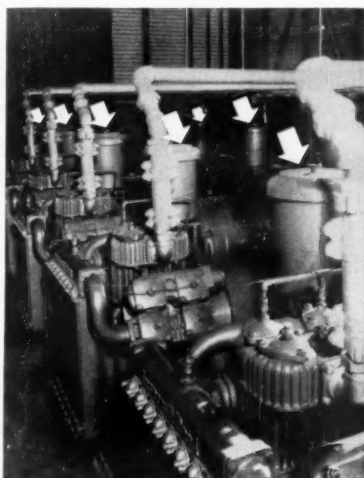
Designed for remote control, Model PON valve recently announced by Ledeen Manufacturing Company features forward, reverse and neutral power operation. A standard 4-way disk valve for



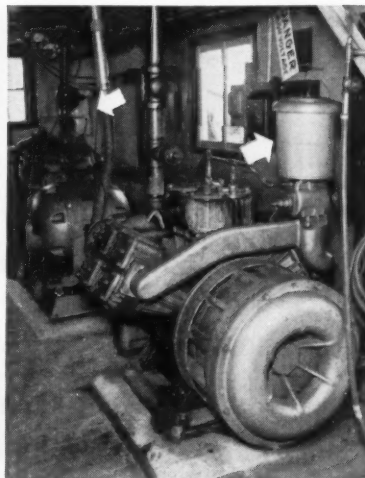
oil, water, air or other gas service, it is controlled by a 3-position power attachment actuated by air or gas. It has a molybdenum-alloy semisteel body for freedom from leaks and an integral disk and stem for maximum rigidity. Body and disk are lapped to optical accuracy

Whether you drive 200-ft. piles or dig intake tunnels...

*Air-Maze filters will keep
your compressors on the go!*



TEN COMPRESSORS SUPPLY AIR for a 200-foot pile driver used in building the foundation for a generating plant at Muskegon, Michigan. Air-Maze oil bath filter silencers scrub intake air clean in a bath of oil, keep airborne dirt from damaging polished moving parts. The silencing feature reduces strain of excessive noise on employees and neighbors.



TO HELP KEEP THIS COMPRESSOR supplying air for a tunneling project at Tonawanda, N. Y., two Air-Maze oil bath filter silencers are used. Result: reduced maintenance costs and downtime. Get the same results yourself. Specify Air-Maze oil bath filters and silencers on the compressors you build or buy.

AIR-MAZE The Filter Engineers

AIR FILTERS • SILENCERS • SPARK ARRESTERS
LIQUID FILTERS • OIL SEPARATORS • GREASE FILTERS

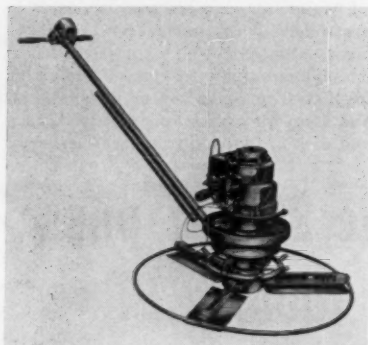
25000 Miles Road • Cleveland 28, Ohio

Circle 20A on reply card

to provide a perfect seal, and the rotating disk construction gives the valve long life.

Circle 9E on reply card

Adaptability characterizes a new troweling machine that can be operated by an air or electric motor or by a 2- or 4-cycle gasoline engine. Switching from one power head to another or to a re-



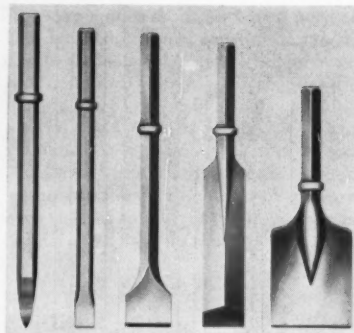
placement engine is facilitated by three interchangeable 3-bladed clamp rings 26, 36 and 45 inches in diameter. The blades are reversible to give double wear, and 97 percent of the power is delivered directly to them, it is claimed, by planetary geared transmission, obviating belt slippage. Other features of the unit are an automatic recoil starter, safety

throttle control and an eye to facilitate lifting and lowering the machine when used inside buildings. In operation, the ring stops and the power unit idles when the handle is released. Manufactured by the Mall Tool Company, the troweling machine may also be used to drive a floating disk and grinding-grouting head.

Circle 10E on reply card

With winter just ahead, maybe the snow shoveler would like to hear about a substance that will do the toilsome job for him. It is reported that when handfuls of tiny balls of Ice-Foe, produced by Walton-March, are spread before, during or after a freeze or snowstorm they create heat on contact with moisture. A nontoxic chemical compound, it is said to have a melting capacity up to 30 times greater than salt and to leave no messy residue to track into the house. The material is sold through janitor and mill supply jobbers as well as hardware and department stores.

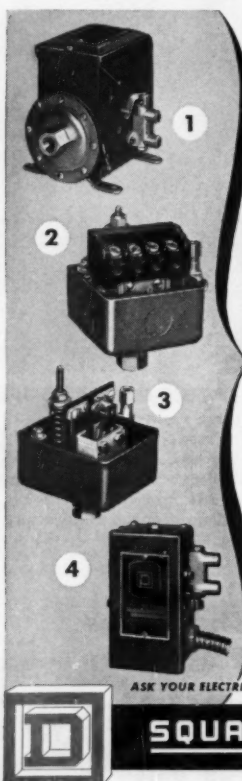
For application in plants handling flammable liquids such as gasoline, naphtha, benzene, lacquers, etc., or where explosive gases or dust are present, Ingersoll-Rand Company now has available a line of paving-breaker, digging and demolition tools. They are made from a special high-strength beryllium-copper alloy, a metal recommended because of



its spark-resisting properties and used for years in casting safety tools. The new products, however, are forged and therefore remain sharp longer than their cast counterparts and also have a longer service life. From left to right, the tools shown in the accompanying picture are: a moil point, narrow chisel bit, 3-inch chisel bit, 3x12-inch digging chisel and a 5-inch asphalt cutter.

Circle 11E on reply card

Tension in wire rope can be measured electrically by a new instrument available from Baldwin-Lima-Hamilton Corporation. It is intended primarily for checking and adjusting loads, especially when distributed among several cables, and is attached anywhere on a line by



SQUARE D

FOR A
Complete Line
OF H.P. RATED
**AIR COMPRESSOR
SWITCHES**

- ① Heavy Duty
- ② Standard Duty
- ③ Gas Engine Cut-Out
- ④ Magnetic Unloader

full range of electrical and pressure ratings

Write for Bulletin 550,
Square D Company, 4041 North
Richards St., Milwaukee 12, Wis.

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

Circle 21A on reply card

**KEEP YOUR COMPRESSOR
AT TOP EFFICIENCY
AT LOW COST WITH A**

CONRADER UNLOADER

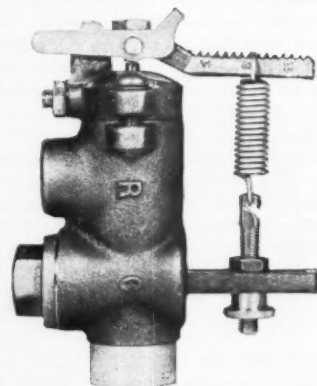
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MANY NATIONALLY
KNOWN AIR COMPRESSORS
USED THE WORLD OVER!

Always fully opened or closed.
Positive and instantaneous action.

Adjustable from 4 to 600 pounds
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Easy to install - Operates in any
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We offer a one-day repair service
on any Conrader Valve regardless of age.



Your Problem Will Get Our Immediate Attention — WRITE TODAY

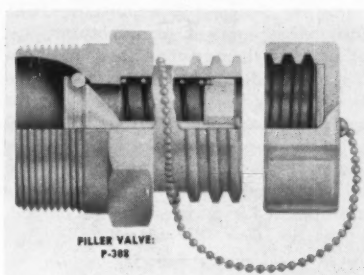
R. CONRADER CO. BOX 924
ERIE, PA.

Circle 22A on reply card

screw clamps. Measurements of force are transmitted from resistance wire strain gauges in the Tensiometer to a central indicator or recording device. The instrument is designed for loads up to 5000 pounds on cables up to 1/2 inch in diameter but can be made for larger weights and sizes.

Circle 12E on reply card

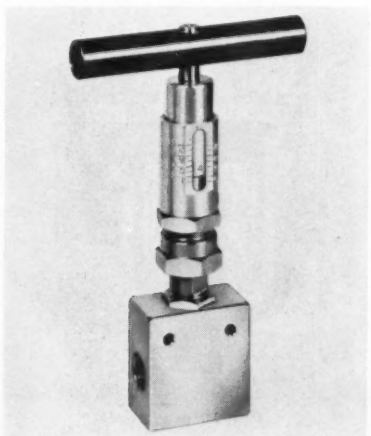
A coupler for the rapid transfer of liquids or gases with safety has been announced by James-Pond-Clark. The Type P-388 consists of a filler valve that is threaded into a tank and of a quick-connecting element between the supply line and the valve. The latter incorporates a check-valve unit that permits flow



into the tank and automatically shuts off tight when the coupler is disconnected. As the gas or solution can be transferred and maintained under pressure there is no loss of vapor or tank pressure. Two other types are available in addition to the one shown: the P1-388, which embodies a valve that prevents dripping when the hose is disconnected, and the P2-388 which is designed to open the check valve for drainage or reverse flow.

Circle 13E on reply card

Patents have been applied for on a high-pressure valve with a micrometer stem developed for testing by High Pressure Equipment Company, Inc., and now in production. Except for chemical changes caused by corrosion and erosion the Micro-Valve makes it possible, it is



Is Your Production calling for FULL CAPACITY ?

put the powerful

Ingersoll-Rand

MOTOR PUMP

on the job !

You can get delivery from 5 to 2800 gallons per minute from Ingersoll-Rand Motorpumps—yet the largest unit requires only about 5' x 2' in floor space! They're designed and built to give you maximum performance with space-saving compactness you'll welcome.

They're exceptionally versatile, too. They operate in any position without need for a baseplate or special mounting. Nor is a coupling required, because the motor's heavy-duty shaft is connected directly to the pumping unit.

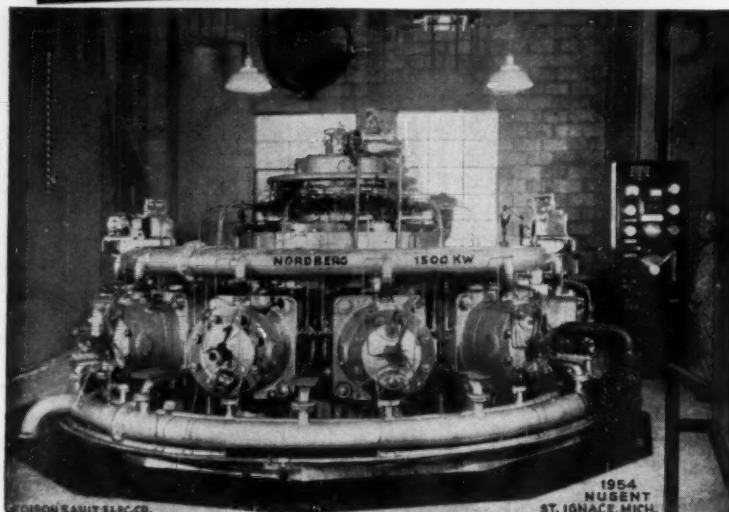
If you want smooth operation from pumps that promise lowest maintenance costs in the field, get more detailed information by writing for our latest Motorpump bulletin showing size 1/4-75 hp.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

Circle 23A on reply card

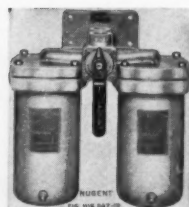
Nugent filters selected as original equipment at St. Ignace power plant



Shown in the view above is a 1500 kw Nordberg Radial Diesel installed by the Edison Sault Electric Co. for municipal power service at St. Ignace, Michigan. Included as original equipment on this diesel was a Nugent Duplex Fuel Oil Filter of the type that removes 99.8% of all foreign solids from the fuel supply. The St. Ignace installation is still another example of Nugent filters being selected as original equipment by a leading diesel manufacturer.

Nugent filters are available in a wide range of sizes and types to meet every need. Size for size they provide 20 times more filtering area than any other filter. Full or by-pass filtering is possible with the same unit and simple piping makes installation easy. These are some of the reasons why leading diesel manufacturers specify Nugent filters as original equipment.

To assure longer life and better service from your own diesel, investigate the possibilities of Nugent filtering. Write today for complete information.



Nugent duplex fuel oil filter of the type used on the new diesel at St. Ignace. Bag type recharges are inexpensive and simple to replace.



Wm. W. Nugent & Co., Inc.
422 N. Hermitage Ave. CHICAGO 22, ILLINOIS

OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS,
OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS
Representatives in Boston • Cincinnati • Detroit • Houston • La Jolla, Colo. • Los Angeles
Minneapolis • New Orleans • New York • Philadelphia • Portland, Ore. • San Francisco
Seattle • St. Louis • Tulsa • Representatives in Canada: Montreal • Toronto • Vancouver

Established
1897

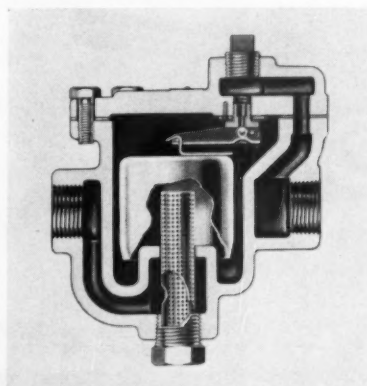
claimed, to duplicate with certainty all tests and readings. Dial settings are made by turning a handle, one complete revolution opening the valve only 0.015 inch. There is a positive stop at "0" so that the unit cannot be thrown out of alignment or the seat ruined by over-tightening. The valve is available in a complete range of tubing sizes up through 9/16 inch and in different metals including stainless steel, hastalloy and titanium for vacuum and pressure up to 60,000 psi.

Circle 14E on reply card

Efficiency and economy where air demand is intermittent are claims made for a new series of moisture separators announced by Wilkerson Corporation. The units are designed especially for OEM (original equipment manufacturer) applications where weight and size are major considerations. Four models are available for 1/4- to 1/2-inch lines and for equipment using air at from 10 to 250 psi. Piston-operated, the action of the Series 125 is fully automatic, and free oil, water and nongaseous contaminants are separated from the air and discharged.

Circle 15E on reply card

An inherent weakness of inverted bucket steam traps is possible loss of prime with consequent blow-through. This is overcome, it is claimed, by a new design offered by Sarco Company, Inc. The Type B, as it is designated, features high discharge capacity and quick action obtained by the use of large valves operated by the company's Camlift valve mechanism. In service, the bucket loses buoyancy and sinks when sufficient steam leaks through the vent. Its weight then pulls on the far end of the bucket arm which acts as a lever to pry the valve head from the seat against which it is held firmly by the steam pressure. The cams of the valve mechanism, which serve as fulcrum points, multiply the leverage and immediately lift the valve head. A slot causes it to drop away from the seat, leaving it wide open for maximum discharge.



Circle 16E on reply card

Circle 24A on reply card

QUOTES

—FROM HERE AND THERE

Prospects As It Ditches

"A mechanical ditching machine to be used by Pacific Northwest Pipeline Corp. in digging a trench from the San Juan basin to the Pacific Northwest will carry a Geiger counter. Company officials got intrigued with the country's uranium possibilities and decided to send the counter along 'just in case.'"

Business Week, June 11

Air Chamber Good Wine Press

"Of interest to juice processors is a new German wine press that applies pressure through an air-inflated rubber chamber, thereby eliminating conventional piston pressing.

"Advantages cited for the unit (Willmes Presser) include: Higher pressing speed, faster juice recovery, better yield, and precise pressure control. Latter avoids pressure on fruit, skins, stones, and stems to avoid bitterness in the juice.

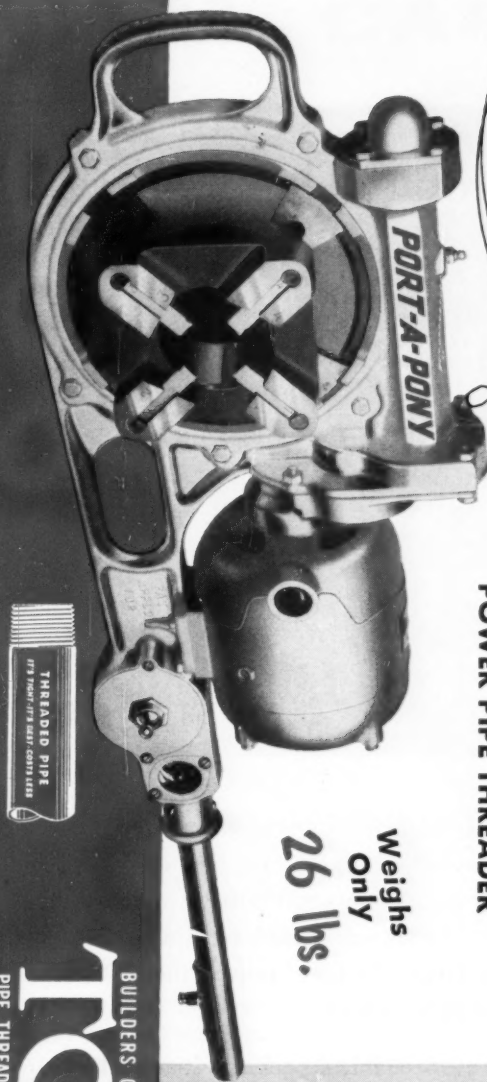
"Unit consists of a steel tank with a central rubber bag and hose connection. While chamber is deflated, tank is loaded with fruit and closed. Then, air is pumped into the hose. Inflation causes equal pressure toward the inside tank wall, which results in uniform pressing.

"Presses are available in three sizes from 132 to 607-gal. capacity."

Food Engineering, August

Air-Oil "Octopus" Keeps Parts Moving

"Frequently a large-force application is required where the use of shop air supply and an air-oil booster is the most economical source of power. In Ford Motor Co. assembly plants, speed of production, and the uninterrupted flow of units through the various stations are



NEW

TOLEDO No. 68
PORT-A-PONY
POWER PIPE THREADER

**Weights
Only**

26 lbs.

TOLEDO
BUILDERS OF THE WORLD'S FINEST PIPE TOOLS
PIPE THREADERS • PIPE WRENCHES • PIPE MACHINES

**LIGHT,
VERSATILE
TIMESAVER**

Here's a new tool that's so chock full of uses it is difficult to list all of them. Though originally designed as a means of power to operate pipe threading tools, it is a highly desirable unit for many other uses. For example: Opening, and closing large valves, winching operations, pulling wire through conduits, hoisting operations, operating augers, cranking operations. The PORT-A-PONY is a powerful portable power drive that will greatly reduce manual labor. Weighs only 26 pounds. Rugged construction, sturdy reversible 1/2 H.P. motor. Send today for new colorful bulletin on the "TOLEDO" No. 68 PORT-A-PONY with all applications illustrated. Remember — if it bears the familiar "TOLEDO" label, you know it's a dependable product. Manufactured by Thread-Ezy Mfg. Co., Subsidiary of The Toledo Pipe Threading Machine Company, 1445 Summit Street, Toledo 4, O.

Circle 25A on reply card

35,000 P. S. I. COMPRESSORS

Sealed with
**FRANCE
HYPER
PACKINGS**

The extremely high pressures now required by some chemical processes have created a new field for compressors and posed problems for mechanical packings considered impossible until France Hyper Packings proved these problems could be solved.

As builders of mechanical packings for nearly 60 years France has lived intimately with the problem of developing special packings for Industry.

The high degree of engineering and craftsmanship required for special service is reflected in the development and production of standard types of packings, piston rings and valve discs.

FRANCE

PACKING CO., PHILA. 15, PA.

Circle 26A on reply card

essential. Each function must be geared to the entire operation, and a shut-down at any point means an immediate slow-down for the entire plant.

"One of the operations is installing the front wheel suspension and compressing the two front springs in order to simulate actual highway load in adjusting the caster and camber of the wheels. This job is done with an air-oil fixture having four air cylinders which lock the fixture in place and two larger oil cylinders which compress the spring. The tool, nicknamed 'Octopus' because of its appearance, permits setting both front wheels for caster and camber at the same time." *Applied Mechanics, August*

Cost Not Too High for Safety

"Fabrication of a new system of painters' scaffolds for the Golden Gate Bridge is . . . under way . . . The scaffolds, to be attached permanently to the bridge, are designed to eliminate accidents like the 1953 scaffold collapse on the bridge that killed two workers. The system, designed by Clifford E. Paine, Golden Gate Bridge district engineer, consists of four units. The largest scaffold will weigh 60 tons. Two will weigh 11½ tons each, and the fourth will weigh 7½ tons.

"Under the contract (\$640,000) the job is to be completed in 270 days. Fabrication of the scaffolds will take place in the Richmond yard of Judson Pacific-Murphy Corp. and then they will be transported—completely assembled—by barge to the bridge."

Engineering News-Record, July 7

No Hit-and-Miss Salting of Juice With Pneumatic Control

"A leading producer of canned tomato juice now salts its juice continuously, using a system based on controlled flow rates. Former practice consisted of passing the open, filled cans under a dispenser designed to drop a salt tablet into each can. The dispenser was not very reliable. Occasionally several tablets were dropped into one can; and sometimes a dozen or more cans would pass through unsalted.

"System now used consists primarily of a mixing vessel, liquid flow rate controller, and gravimetric salt feeder. The strained, uncooked juice passes through a sanitary flow meter, which transmits electric signal to recorder-controller. This instrument regulates a pneumatic control valve. Rate is controlled at about 40 gpm. Juice then flows into mixing vessel, together with salt from gravimetric feeder. The two are thoroughly mixed by an agitator in the vessel. Salted juice then flows through an overflow in the vessel to can-filling operation."

Food Processing, August

Industrial Literature

Two new catalogues of technical reports—CTR-159, *Electroplating and Polishing*, and CTR-311, *Photochemistry and Photoelectricity*—have been compiled by the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Most of the more than 250,000 documents listed are reports of research done under Government sponsorship by either Government or private laboratories and some are technical papers captured by the Allies in Germany during World War II. Copies of all are available. Price of each catalogue is ten cents.

A new data sheet giving specifications and uses of eleven grades of compressed asbestos sheet packing is offered by B.F. Goodrich Company's Industrial Products Division.

Circle 17E on reply card

National Forge & Ordnance Company is distributing a large 12-page calendar showing current, preceding and succeeding months on each page, together with illustrations of the plant and products.

Circle 18E on reply card

Bulletin H-2 describes Conoflow Corporation's full line of precision-made pneumatic regulator equipment. The indexed, 8-page brochure is illustrated with cross-sectional and dimensional drawings and lists typical applications.

Circle 19E on reply card

Lever and rotating cam-type limit switches are the subject of Bulletin GEA-6131A offered by General Electric Company. Features of the products are discussed and ratings, dimensions and typical applications are listed.

Circle 20E on reply card

Freeland Gauge Company has prepared an 8-page brochure illustrating and describing a variety of its standard and special gauges and measurement control methods for close-tolerance work in the automotive, aircraft and metalworking industries.

Circle 21E on reply card

Bulletin VCA-55 announced by Colonial Broach & Machine Company deals with the construction, operation and controls of its 138-inch-high continuous broaching machine with an effective stroke length of 154 inches. The machine represents a new approach to high-speed surface broaching.

Circle 22E on reply card

A new line of pressure hose and reusable couplings to be used in making up hose assemblies for heavy-duty applications has been announced by The Imperial Brass Manufacturing Company in its catalogue No. 3040-A. Assembly instructions are included for each type of hose, and accessories are listed.

Circle 23E on reply card

Literature dealing with a new swivel-type large-bore tire valve for earthmovers and other heavy off-the-road vehicles with big tires is obtainable from A. Schrader's Son. Structural features of the valve are shown, together with accessory equipment.

Circle 24E on reply card

How the flexibility of electronic temperature controls makes them useful in a wide range of commercial heating and air-conditioning installations is explained in a booklet distributed by Minneapolis-Honeywell Regulator Company, 2753 Fourth Avenue, South, Minneapolis 8, Minn. Designed to

VITAL CARGO



There's vital cargo passing through this Naylor Spiral-weld pipe because this line is pushing in fresh air to the heading and pulling out stale air, gases and fumes. There's no more vital ingredient than air in underground construction and no better vehicle for it than this distinctive pipe. Lightweight makes Naylor easy to handle and install as work progresses . . . particularly with the one-piece Naylor Wedge-Lock coupling to speed connections. Extra strength and safety are other performance features built into this pipe.

Write for Bulletin No. 507 for the complete story.



1245 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

Circle 27A on reply card

Putting the Thruway Thru

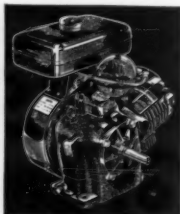


... with a Big Assist from Red Seal Power

Specialized machines such as this Model "GB" Blaw-Knox Precision Subgrader account for the amazing rapidity with which the highway network is expanding to meet this country's needs. This unit, with its extra discharge horn permitting discharge of spoil at either end, is only one of a steadily-lengthening list of special-purpose equipment utilizing Red Seal power. You find Red Seals, today, building prestige for the makers—and earning profits for the users—of leading makes of pavers, graders, mixers, compressors, earth-movers, ditchers, shovels, rollers and numerous other machines. You can clinch on-time performance by standardizing on equipment which offers the plus-value of dependable Red Seal power.

4-CYCLE ENGINES FOR INDUSTRY AND FARM

In addition to its large engines, Continental builds an outstanding line of heavy-duty air-cooled four-cycle models for farm and industrial applications requiring 2 to 3 h.p. Advanced engineering gives them easy starting, high dependability, and unusual lugging capacity at low speeds . . . Op-



tions: patented and exclusive Context® external ignition system, low-level ignition cut-off, 6-1 reduction gear, and other features. Available also for use on kerosene . . . For information on these models, address Air-Cooled Industrial Engine Division, 12800 Kercheval Ave., Detroit 15, Michigan.

SERVICE FACILITIES AND GENUINE RED SEAL PARTS
ARE AVAILABLE EVERYWHERE

Continental Motors Corporation

MUSKEGON • MICHIGAN

6 EAST 4TH ST., NEW YORK 17, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 910 S. BOSTON ST., ROOM 1008, TULSA, OKLA.
1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Circle 28A on reply card

fill a gap between the theory of electronic bridge circuits and specific control layouts and circuit diagrams, it is primarily written for the consulting engineer and architect.

The Alpha Molykote Corporation is distributing a bulletin—103A—on its line of industrial lubricants. A revised edition, it includes a selector chart which describes seventeen molybdenum-disulfide lubricants, the carrier in each, the temperature range for best operation and the proper method of application.

Circle 25E on reply card

The 35th annual edition of *Automobile Facts and Figures* has been published by the Automobile Manufacturers Association, New Center Building, Detroit 2, Mich. A comprehensive digest of 80 pages, it contains tables, charts and indexes covering a wide range of subjects relating to motor-vehicle production and use.

Hydraulic and Air-driven Components is the title of a 36-page catalogue (No. 555) offered by Star Jack Company, Inc. In addition to a representative cross section of its well-known products it describes and illustrates new equipment and the services the company is prepared to render in the field of pumps, cylinders, jacks, braces, etc.

Circle 26E on reply card

Efficient storage with steel shelving and how it can be obtained are matters discussed in a 48-page illustrated catalogue (FF 188) released by Remington Rand. It covers steel storage shelving, cabinets and shop equipment and is designed to assist users in selecting items to meet standard and special requirements.

Circle 27E on reply card

Specifications and descriptions of 68 different kinds of rubber hose for industrial and agricultural uses are presented in an 8-page digest published by the Industrial Rubber Division of the Thermoid Company. The brochure also contains data on conveyor, flat power-transmission and other types of belts, chute lining, sheet packing and industrial friction materials.

Circle 28E on reply card

Eight 16-mm sound-color movies each describing steel making and the manufacture of one or more specialty products are offered on a free loan basis by The Colorado Fuel & Iron Corporation. Suitable for all age groups, the selection includes one entitled *Indian Paint*, which shows how iron ore

ON AIR



Cavanaugh

"Well, let's see how the world shapes up tonight . . . Ah, I see it's still round."

was used by the early Indians to make war paint. The films may be obtained from the Advertising Department, The Colorado Fuel & Iron Corporation, 575 Madison Avenue, New York 22, N. Y.

Up-to-date data on the properties and methods of fabricating titanium are contained in a booklet obtainable from the Pigments Department of E. I. du Pont de Nemours & Company, Inc. Mechanical properties of both alloyed and unalloyed grades are tabulated, the properties of titanium and other pure metals are compared and methods of fabrication are discussed.

Circle 29E on reply card

An interplant or mine communications system known as the Audio Safety System is described in Bulletin No. 1601-8 published by Mine Safety Appliances Company. Tailored to fit individual needs, it can be used among other things to transmit safety instructions or information that must be dispatched with speed and accuracy. A schematic diagram shows a typical installation.

Circle 30E on reply card

A technical and application manual, TM-951-1, on the Series 95 proximity meter, an electronic instrument that measures specimens without touching them, may be obtained from the Fielden Instrument Division, Robertshaw-Fulton Controls Company. The chief purpose of the booklet is to help research men and industry find solutions to problems in precision measurement.

Circle 31E on reply card

A 12-page bulletin offered by The Bristol Company describes its line of 6-inch strip-chart recorders for pressure, liquid level, temperature, flow and mechanical motion and contains installation drawings showing methods of applying them to different variables. Use of the instrument as a receiver for remotely generated pneumatic or electric signals is also discussed.

Circle 32E on reply card

Denver Equipment Company has published a 76-page catalogue, LG3-B10, describing more than 146 pieces of laboratory equipment for testing ore. Construction, capacities, horsepower requirements, and operating features of each item are covered. The purpose of the book, which also deals comprehensively with the company's own ore-testing division, is to help metallurgical departments set up laboratories of their own.

Circle 33E on reply card

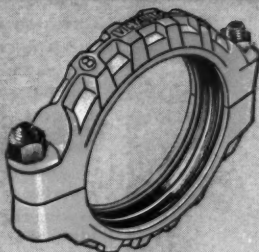


"I can't possibly work nights—I walk in my sleep."

VICTAULIC

METHOD

OF PIPING



VICTAULIC COUPLINGS

Styles 77, 77-D for standard applications. Simple, fast to install—sturdy and reliable. Sizes $\frac{3}{4}$ " to 30". Style 75 Light-Weight Couplings for light duty applications. Sizes 2", 3", 4". Additional styles for cast iron, plastic and other pipes. Sizes through 60".



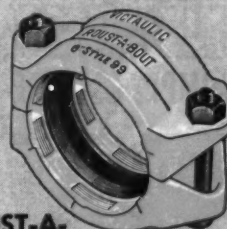
VICTAULIC FULL-FLOW FITTINGS

Complete line of Elbows, Tees, Reducers, Laterals, etc.—to fit all Victaulic Couplings. Streamlined for top efficiency, easy to install. Sizes $\frac{3}{4}$ " to 12".



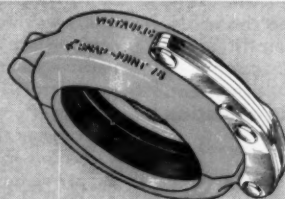
VIC-GROOVER TOOLS

Handy, on-the-job grooving tools that do the work in half the time. Light weight, easy to handle—operate manually or from any power drive. Automatic groove position and depth. Sizes $\frac{3}{4}$ " to 8".



ROUST-A-BOUT COUPLINGS

Style 99 for plain or beveled end pipe. Best engineered, most useful plain end joint on the market. Simple, husky—easy and fast to install. Takes strong bull-dog grip on pipe. Sizes 2" to 8".



VICTAULIC SNAP-JOINTS

Victaulic's new boltless, speed coupling. — Style 78 — hinged into one assembly. Hand-locks for time and dollar savings. Sizes 1", 1 $\frac{1}{4}$ ", 2", 3", 4".

EASIEST WAY TO MAKE ENDS MEET

Promptly available from distributor stocks coast-to-coast. Write for NEW Victaulic Catalog-Manual 55-11B

VICTAULIC
COMPANY OF AMERICA
P. O. Box 509 • Elizabeth, N. J.

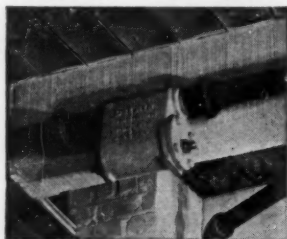
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and

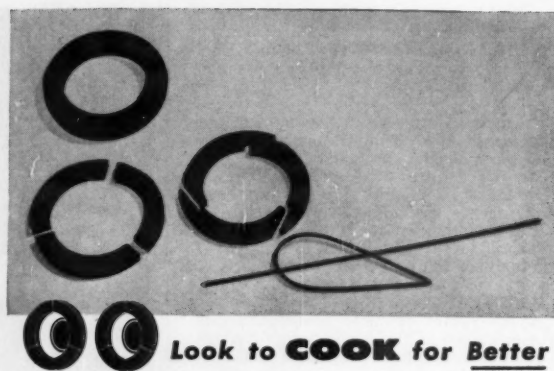
oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

Circle 30A on reply card

Adv. 32



Look to **COOK** for Better
PACKING RINGS!

MATERIALS

GRAPHITIC IRON
(Exclusive with Cook)

COOKMET

(No. 1—Plastic Bronze)
(No. 2—Semi-Plastic Bronze)
(No. 3—Alloy Bronze)

BABBITT

(Highly Anti-Frictional)

COOKROC

(Laminated Bakelite: Standard,
Hi-Temp and Graphitized)

CARBON

(For Non-Lubricated Service)

C. LEE

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COMPANY

Sealing Pressures Since 1888

Circle 31A on reply card

How to step up compressor performance

You know how *over-cooling* (1) causes condensation in cylinders which destroys lubricant, increases wear; (2) wastes water.

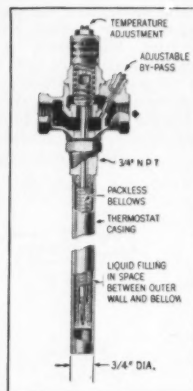
Under-cooling reduces compressor capacity—often damages cylinders, pistons, valves, seats.

You can easily avoid these costly troubles by equipping your compressors with simple, inexpensive Sarco self-powered cooling controls. They insure optimum cooling effect with minimum water consumption...regardless of variations in load, pressure, and supply water temperature.

Write for Handbook 520-A "Is Your Air Compressor Capacity Effective?"

SARCO COMPANY, INC.
EMPIRE STATE BUILDING, N.Y. 1, N.Y.

Circle 32A on reply card



SARCO T-44 COOLING CONTROL

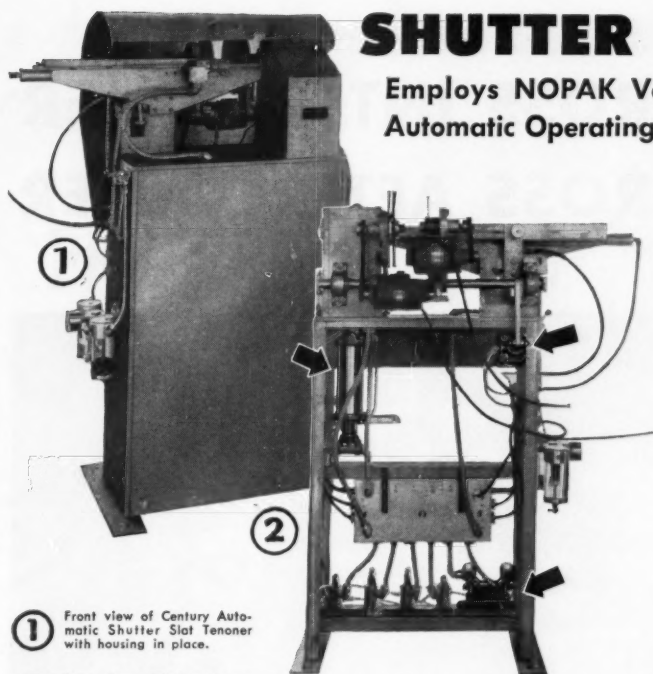
Self-powered—requires no electrical or compressed air hook-up. Adjustable temperature ranges.

Inexpensive; less than \$40

Complete Sarco line includes Cooling Controls with remote bulbs.

2120-F

COMPRESSED AIR MAGAZINE



① Front view of Century Automatic Shutter Slat Tenoner with housing in place.

② Rear view with housing removed, shows 2 NOPAK Model E Cylinders and NOPAK Model V250-R Slide Valve.

SHUTTER SLAT TENONER

Employs NOPAK Valves and Cylinders to Implement Automatic Operating Cycle

This completely automatic machine, built by Century Tool and Engineering Co., Culver City, Cal., turns out 1200 tenoned wood shutter slats per hour, *automatically*. It cuts dowel-like projections on both ends of each slat and cuts the individual pieces to length. The machine continues to re-cycle automatically until the complete length of stock is cut into tenoned shutter slats.

The cutter head is moved into position by a 2" x 2" Model E NOPAK Cylinder. The stock is rotated 360°, during the cutting operation, by a NOPAK 2½" x 6" cylinder, controlled by a NOPAK Model V250-R Slide Valve.

This is but one example of how NOPAK Valves and Cylinders are used in automated operating cycles in many types of machinery and equipment. For other examples, ask your NOPAK Representative to show you the NOPAK Application Manual.

NOPAK
® VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

GALLAND-HENNING NOPAK DIVISION
2759 SOUTH 31ST STREET • MILWAUKEE 46, WISCONSIN

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A-8525-1½-HA

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and for intake and exhaust noises
use **BURGESS-MANNING SNUBBERS**

They are the surest way to eliminate nerve-racking intake and exhaust noises from engines, compressors, blowers, vacuum pumps, steam or gas turbines, etc. They promote better neighbor and employee relations — eliminate needless strain, fatigue and costly errors in oral communication and improve equipment efficiency. "PLUS" functions of spark arresting, heat recovery, water separating, air cleaning, and surge control can be integrally included.

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Sound Engineering 757 East Park Avenue, Libertyville, Illinois
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Compressed Air Data (Fifth Edition) \$3.00
Cameron Hydraulic Data (Twelfth Edition) 3.00

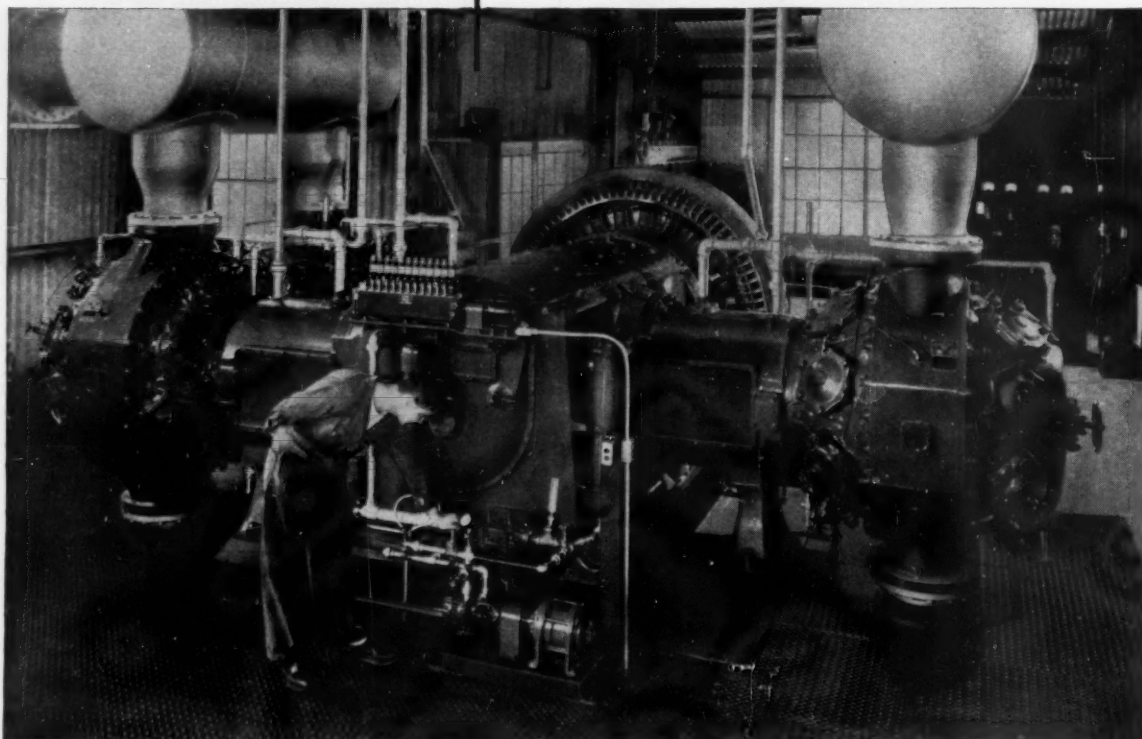
COMPRESSED AIR MAGAZINE, 942 Morris Street, Phillipsburg, New Jersey.
Please send me:

- ☐ Compressed Air Data and Cameron Hydraulic Data...Both books for \$5.00.
☐ Compressed Air Data.....\$3.00
☐ Cameron Hydraulic Data.....\$3.00
☐ Enclosed is (money order) (check) for \$..... ☐ Send books C.O.D. I understand that the books will be sent me postpaid, and that they may be returned within 10 days if not satisfactory.

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Company
Street No.
CityStateCountry

for the vital processing
of antibiotics
this air compressor is
equipped with

ROSS INTERCOOLER ROSS AFTERCOOLER



Providing a continuous supply of air for the production of urgently needed antibiotics, this leading make compressor has been in virtually constant 24-hour-a-day operation since installation over a year ago. Because moist air or air failure could well be disastrous in the processing of costly terramycin, this compressor has been equipped for utmost dependability. A Ross Intercooler and a Ross Aftercooler assure cool, dry air *at all times*.

Unsurpassed for ruggedness and high thermal efficiency, Ross Intercoolers, Aftercoolers and Lube Oil Coolers are regularly selected by numerous compressor builders and users. Another reason: prompt availability of standard-

ized designs and sizes to fulfill most needs.

Detailed literature will be mailed on request.

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KEWANEE-ROSS CORPORATION

DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
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"Used many makes of turbines... **PREFERS COPPUS**"

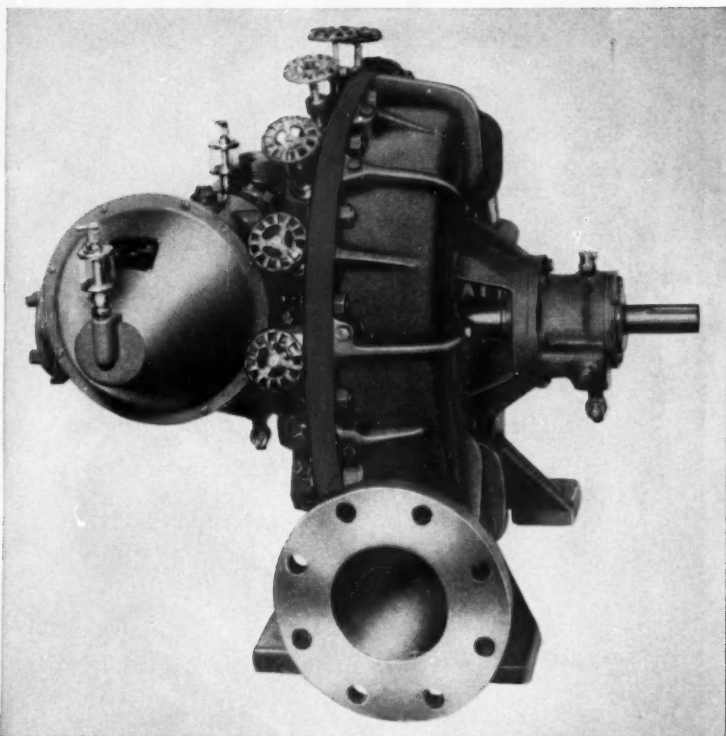
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

"I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

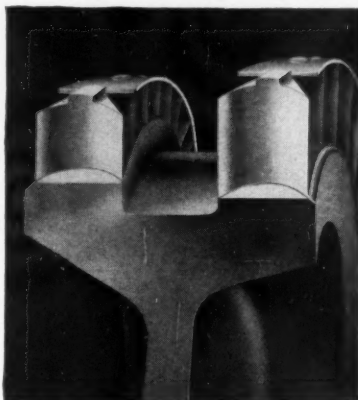
Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

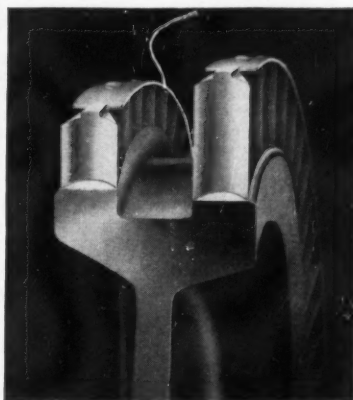
COPPUS ENGINEERING CORPORATION
211 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER



This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.

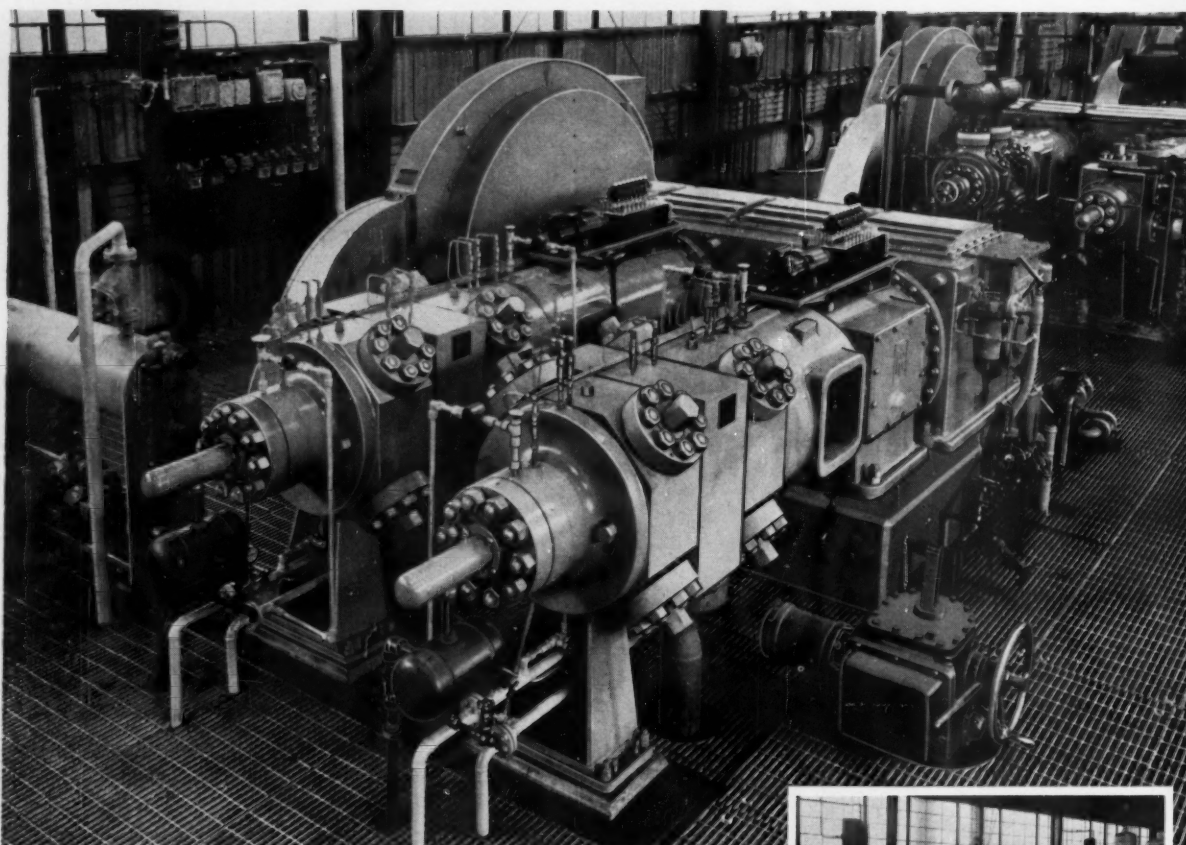


This wide bucket "L" type wheel is a new development for use where low water rate is essential.



This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

COPPUS "BLUE RIBBON" **TURBINES**



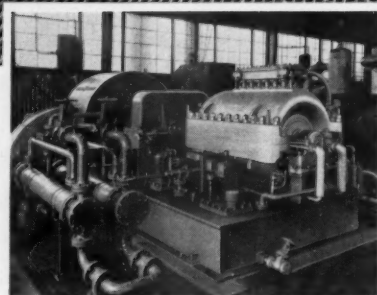
Synthesis gas that did not combine to form ammonia during its stay in the converter is recirculated by this HHE compressor. Each of the two cylinders increases the pressure of the hydrogen-nitrogen mixture 400 psi. Design maximum working pressure is 3815 psia. This 212 cfm unit is driven by a 500 hp motor.

PRESSURE is an all important factor in the manufacture of synthetic ammonia. Many different pressures, high and low, must be held to the exact process requirements. Also, the nature of the gases being compressed varies due to differences in chemical properties.

At the Atlantic Refining Company's new ammonia synthesis plant, all pressure and capacity requirements are easily met by the I-R centrifugal compressor and the seven versatile HHE reciprocating compressors, a total of 6110 horsepower. Air and seven other gases or mixtures of gases are handled by these heavy-duty units.

This is an interesting example of the *complete flexibility* of I-R process compressor design. Either centrifugal or reciprocating compressors can be supplied, whichever type best meets existing economic conditions. Or, as in this plant, both types of compressors may be used in conjunction with each other.

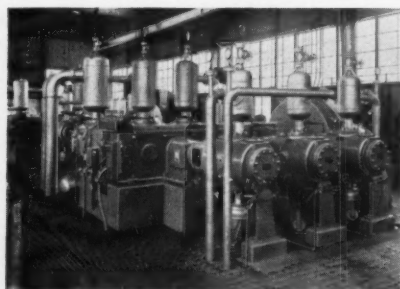
Whatever the process, you can meet your *exact requirements* with process-engineered Ingersoll-Rand compressors. It will pay you to call in your I-R representative on your next job.



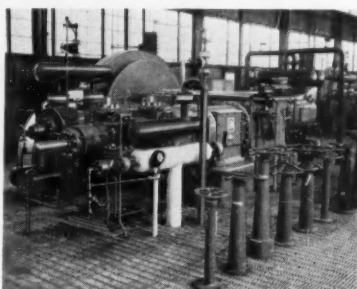
Air is compressed in this 1750-hp centrifugal compressor for liquifaction and separation of nitrogen. The nitrogen is combined with the hydrogen to form the synthesis gas and for a nitrogen wash in gas purification.

Here's How I-R Equipment PUTS THE PRESSURE ON AMMONIA PRODUCTION

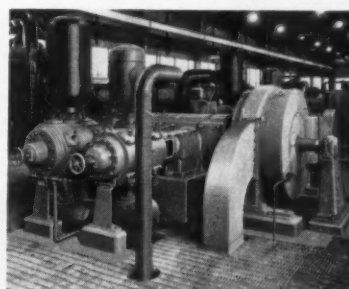
at the Atlantic Refining Company's
Synthesis Plant in Philadelphia



Methane, ethylene and propane gases are handled as separate streams in this six cylinder HHE compressor. Two of these 450-hp units provide the necessary low temperature cascade refrigeration for gas purification.



Nitrogen and synthesis gas are handled separately by this dual purpose compressor. Two of the cylinders compress 75 % H₂ and 25 % N₂ to reactor operating pressure in two-stages. Maximum reactor pressure is 3815 psia. The third cylinder compresses 100 % N₂ in two-stages. Each of the two units on this service is driven by a 1080-hp motor.



Refrigeration is also necessary to condense the newly formed synthetic ammonia. This and other plant refrigeration requirements are provided by the two 400-hp ammonia refrigeration units shown here.

..... **Ingersoll-Rand**

1-287

11 Broadway, New York 4, N. Y.



CENTRIFUGAL PUMPS

CONDENSERS

GAS AND DIESEL ENGINES

NOVEMBER, 1955

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Adv. 37



Wire Rope at Work—This is part of the steelwork for a brand-new building on New York's East Side. It will be a beautiful multicolored structure topped by a striking blue tower. When completed, the building is to be known as 711 Third Avenue. "711" will usher in an era. It is expected to pioneer an exciting period of new construction on Third Avenue—a development forecast by the razing of the elevated railway.

As the steelwork for 711 went up, Bethlehem wire rope was much in evidence. You see some of it in the photograph: that hoist line, for instance, descending from the derrick boom. The rope was Purple Strand, of course, Bethlehem's toughest grade, and it handled those heavy structural members as if they were straws. A typical assignment for Purple Strand, one duplicated many times a year in every part of the country.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

CONSTRUCTION • MINING • PETROLEUM • EXCAVATING • QUARRYING • LOGGING • MANUFACTURING





PLASTIC

VALVES and
PIPE FITTINGS

by

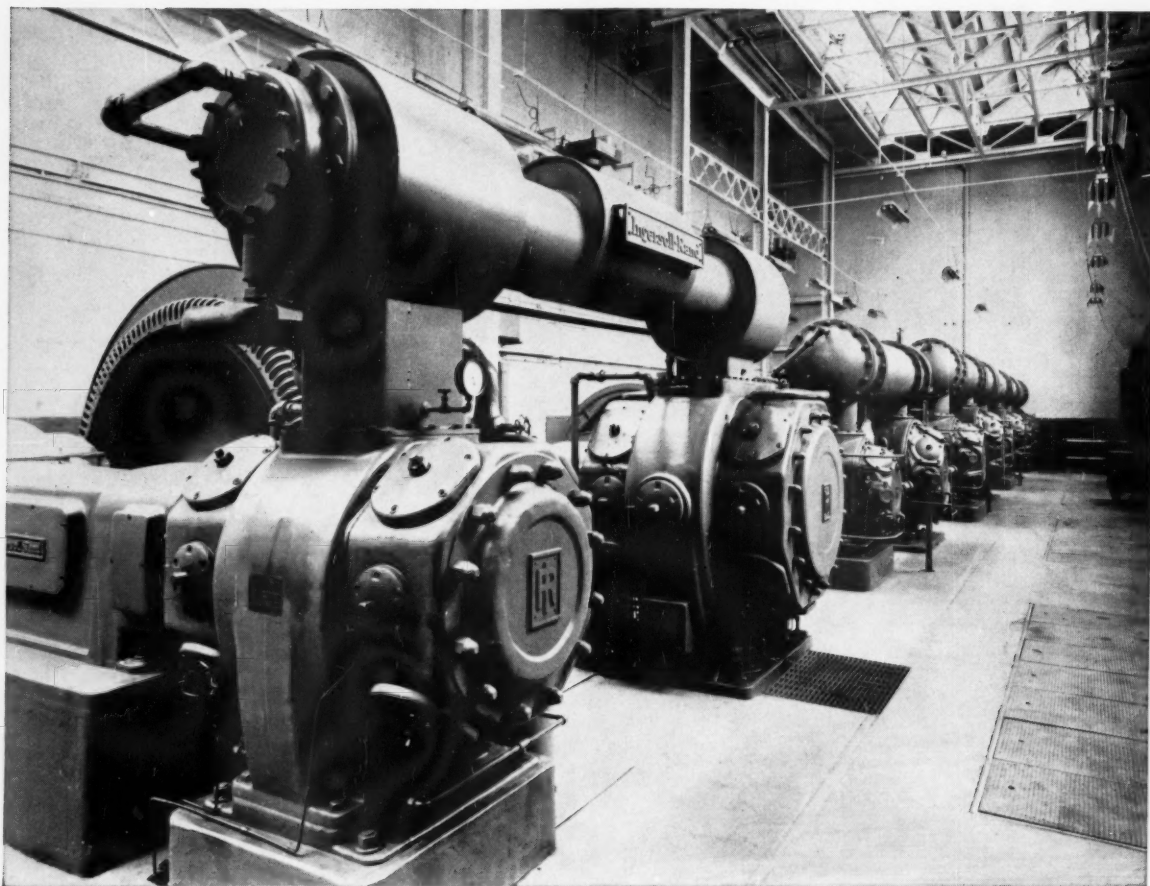
WALWORTH



These new corrosion-resistant valves and pipe fittings are molded of rigid polyvinyl chloride.

They round out complete lines of Walworth Valves and Fittings of Steel, Stainless

Steel, Bronze, Iron, and Special Alloys. A brochure explaining the complete Walworth PVC product story has been prepared for your information. Just send us your name and address. *Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.*



Compressor efficiency is a matter of fact

Fact No. 1: Air compressors run more efficiently — and at lower cost — when you lubricate with *Texaco Regal Oil R&O*.

Fact No. 2: This specially-refined oil keeps rust and harmful deposits out of the system . . . assures clean lines, proper functioning of rings and valves.

Fact No. 3: Compressors thus give better performance on the job, require less time and money for maintenance.

Texaco Regal Oil R&O is made from premium-quality base stocks, then is further improved by

effective additives and extra processing. The complete line of these superior oils meets the requirements of every type and size compressor, every operating condition. One of them will be just right for your compressors.

You can count on consistently high performance from all your equipment when you employ the proper lubricants. A Texaco Lubrication Engineer has all the information you'll need. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.



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FOR ALL AIR COMPRESSORS AND OPERATING CONDITIONS

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